

**Before the  
Federal Communications Commission  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Amendment of Part 2 of the Commission's Rules	)	
to Allocate Spectrum Below 3 GHz for Mobile	)	
and Fixed Services to Support the Introduction	)	ET Docket No. 00-258
of New Advanced Wireless Services, Including	)	
Third Generation Wireless Systems	)	
	)	
Amendments to Parts 1, 2, 27 and 90 of the	)	
Commission's Rules to License Services in the	)	
216-220 MHz, 1390-1395 MHz, 1427-1429 MHz,	)	WT Docket No. 02-8
1429-1432 MHz, 1432-1435 MHz,	)	
1670-1675 MHz, and 2385-2390 MHz	)	
Government Transfer Bands	)	

**JOINT COMMENTS OF  
THE NATIONAL ASSOCIATION OF BROADCASTERS AND  
THE ASSOCIATION FOR MAXIMUM SERVICE TELEVISION, INC.**

November 3, 2003

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## SUMMARY

As part of a reallocation plan designed to help clear the 1710-1755 MHz segment to support new advanced wireless services, the Commission proposes to allow DoD use of the 2025-2110 MHz band on a “co-equal, primary basis” with non-governmental operations, for 11 DoD sites that support certain military space operations. Currently, the 2025-2110 MHz band is used primarily by the Broadcast Auxiliary Service (“BAS”).

The Commission makes clear that, in keeping with its policies, relocation of DoD operations to the 2 GHz BAS band may not constrain BAS operations, and that coordination will be required to prevent interference to BAS operations. However, the Joint Broadcasters believe that it is impossible for the Commission to accurately assess the potential impact of the relocated DoD operations because NTIA has not yet released details on the technical parameters of the 11 DoD systems slated for relocation that are necessary to make such an assessment.

In the absence of such data, the Joint Broadcasters commissioned two studies. The first study is designed to better quantify the universe of 2 GHz BAS licensees that would need to coordinate with each of the 11 DoD facilities. The second study is designed to estimate the interference potential of the DoD facilities with BAS stations located in their vicinity, based on publicly available data.

The studies reveal that the Commission seriously underestimates the impact that the DoD facilities will have on BAS licensees. The first study illustrates that many BAS stations will have to engage in ongoing, proactive coordination with DoD to avoid interference from the TT&C operations. The second study demonstrates that numerous BAS stations will experience harmful interference from the DoD facilities, and under certain conditions, will be completely overloaded and therefore rendered useless.

BAS represents a vital method for delivering breaking news and emergency information to the American public. Among other things, the 2 GHz BAS band is used to transmit live, on-the-spot news coverage, and unique camera transmissions that enhance coverage of special events. In addition, STL and ICR fixed links in the 2 GHz band enable stations in less urban areas to transmit programming to remote communities. It is one of the most important tools that television broadcasters use in delivering localized news and information to their local communities. Moreover, the use and importance of BAS services has expanded in recent years, making it even more critical that DoD operations in the 2 GHz band not impair BAS services.

Based on this analyses, the Joint Broadcasters now must oppose the Commission’s proposed relocation of DoD facilities to the 2 GHz BAS band, at least until such time as NTIA makes available detailed information on the relevant TT&C operations that enables the broadcasting industry to make a full and accurate assessment of the potential impact the DoD facilities will have on BAS services, and determine that successful coordination is a realistic possibility.

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**I. INTRODUCTION**

The National Association of Broadcasters (“NAB”) and the Association for Maximum Service Television, Inc. (“MSTV”)<sup>1</sup> (collectively, “Joint Broadcasters”) submit these comments in response to the Commission’s *Fourth Notice of Proposed Rulemaking* in the above-captioned proceedings.<sup>2</sup> In the *Fourth Notice*, the Commission proposes to make spectrum available for U.S. Department of Defense (“DoD”) operations that will be displaced from the 1710-1850 MHz band as a result of clearing the 1710-1755 MHz segment to support new advanced wireless services (“AWS”), including third

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<sup>1</sup> NAB is a non-profit incorporated association of radio and television stations that serves and represents the American broadcast industry. MSTV is a non-profit trade association of local television stations committed to achieving and maintaining the highest technical quality for the local broadcast system.

<sup>2</sup> 18 FCC Rcd 13235 (2003) (“*Fourth Notice*”).

generation wireless (“3G”) systems.<sup>3</sup> As part of this transition, the Commission proposes to allow DoD use of the 2025-2110 MHz band on a “co-equal, primary basis” with non-governmental operations, for 11 earth stations sites that support military space operations known as tracking, telemetry and commanding (“TT&C”).<sup>4</sup>

Currently, the 2025-2110 MHz (the “2 GHz BAS”) band is used primarily by the Television Broadcast Auxiliary Service (“BAS”).<sup>5</sup> On June 27, 2000, in the *2 GHz Relocation Order*, the Commission reduced the frequency band devoted to BAS services from 1990-2110 MHz to 2025-2110 MHz by reallocating the 1990-2025 MHz segment to mobile-satellite services (“MSS”).<sup>6</sup> At the present time, BAS stations continue to use the entire 1990-2110 MHz band while the Commission works to create a fair and efficient plan for relocating BAS operations.<sup>7</sup> In the *2 GHz Relocation Order*, the Commission also upgraded DoD allocations in the 2 GHz BAS band from secondary to co-primary, but with the stipulation that governmental operations not constrain the deployment of BAS services.<sup>8</sup>

In the *Fourth Notice*, the Commission essentially proposes to adopt a plan offered by the National Telecommunications and Information Administration (“NTIA”) in a

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<sup>3</sup> *Second Report and Order in ET Docket No. 00-258*, 17 FCC Rcd 23193 (2003) (“*AWS Second Report and Order*”).

<sup>4</sup> *Fourth Notice*, 18 FCC Rcd at 13236. See *infra* Table 1 for a list these earth stations.

<sup>5</sup> 47 C.F.R. § 74.602.

<sup>6</sup> *Second Report and Order and Second Memorandum Opinion and Order in ET Docket No. 95-18*, 15 FCC Rcd 12315 (2000) (“*2 GHz Relocation Order*”).

<sup>7</sup> See, e.g., *Order in ET Docket No. 95-18*, DA 03-2838 (*rel.* Sep. 5, 2003) (extending the period for mandatory negotiations between MSS and BAS providers while the Commission considers outstanding issues concerning BAS relocation).

<sup>8</sup> This requirement echoes footnote US346 of the U.S. Table: “[U]se of the band 2025-2110 MHz by the Government space operations service . . . shall not constrain the deployment of the Television Broadcast Auxiliary Service . . . . To facilitate compatible operations between non-Government terrestrial receiving stations at fixed sites and Government earth station transmitters, coordination is required.”

report submitted in 2002.<sup>9</sup> Specifically, both the Commission and NTIA have concluded that granting DoD co-equal, primary access to the 2 GHz BAS band for TT&C uplinks at the 11 earth stations would make more spectrum available in the 1755-1850 MHz band for the relocation of DoD systems from the 1710-1755 MHz band; the latter segment could then be used to facilitate the introduction of new AWS.<sup>10</sup> The Commission states that this proposal would enable DoD to better harmonize U.S. space operations with the rest of the world because the 2 GHz BAS band is the principal TT&C uplink band outside the United States.<sup>11</sup>

The Joint Broadcasters did not initially object to the *NTIA Report*. In fact, the broadcasting industry applauded NTIA and the Commission for their efforts to identify federal spectrum use that may be reallocated in order to facilitate new and innovative wireless services.<sup>12</sup> We noted that broadcasters also are doing their part, including the return of broadcast channels 52-69 for new wireless and public safety services as part of the digital transition, and as mentioned above, the industry's agreement to shrink its use of the 2 GHz band for BAS services to accommodate MSS services.<sup>13</sup>

However, the Joint Broadcasters cautioned both NTIA and the Commission that, pursuant to the Commission's rules and footnote US346, DoD occupation of the 2 GHz BAS band may not constrain or disrupt existing or future BAS operations.<sup>14</sup> Therefore,

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<sup>9</sup> *An Assessment of the Viability of Accommodating Advanced Mobile Wireless (3G) Systems in the 1710-1770 MHz and 2110-2170 MHz Bands*, National Telecommunications and Information Administration, July 22, 2002 ("*NTIA Report*").

<sup>10</sup> *Fourth Notice*, 18 FCC Rcd at 13249-50; NTIA Report at 2-3.

<sup>11</sup> *Id.*

<sup>12</sup> Joint Broadcasters Comments in ET Docket No. 00-258 (filed Aug. 8, 2002) ("*Joint Broadcasters MSS Comments*").

<sup>13</sup> See *supra* note 6.

<sup>14</sup> *Joint Broadcasters MSS Comments* at 8; see also *supra* note 8.

both the Joint Broadcasters and the Commission asked NTIA to disclose the technical parameters of all DoD ground systems designated for relocation to the 2025-2110 MHz bands so that their impact on BAS services can be assessed.<sup>15</sup> To date, unfortunately, NTIA maintains that it has not yet developed the information, adding only that DoD is willing to assume the full burden of coordinating the earth stations so as to avoid causing interference to incumbent BAS operations.<sup>16</sup>

In the absence of NTIA information, the Joint Broadcasters therefore endeavored to assess the impact of the proposed relocation based on publicly available data. Following this analysis, as described below, the Joint Broadcasters must strenuously oppose the relocation of the 11 DoD TT&C sites to the 2 GHz BAS band, at least until such time as NTIA provides details about the technical parameters of the relocated DoD operations that will eliminate the broadcasting industry's concerns over interference to existing and future BAS services.

## **II. DISCUSSION**

### **A. The Commission Underestimates the Impact on BAS Operations**

In the *Fourth Notice*, the Commission states that its licensing records show that there are 1262 call signs operating in the 2 GHz band.<sup>17</sup> The Commission also observes that many of the DoD TT&C earth stations in question are located either within or very close to large television markets, and that DoD TT&C earth stations typically use extremely large antennas (*e.g.*, some reach 65 feet in diameter) and high transmitter

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<sup>15</sup> *Id.*

<sup>16</sup> *Fourth Notice*, 18 FCC Rcd at 13250.

<sup>17</sup> *Id.* at 13251.

powers to produce very powerful mainbeams that cover very large areas.<sup>18</sup> The Commission thus finds that coordination will be required between DoD and BAS services operating in the 2 GHz band.<sup>19</sup> Indeed, the Commission seems to assume that any potential interference between governmental and non-governmental operations should be easily preventable by coordination or additional circumstances like terrain shielding or the fact that some of the antennas may be pointed out to sea.<sup>20</sup>

The Joint Broadcasters disagree. Although counting call signs can be a useful exercise, it is an oversimplified, inadequate method of measuring the magnitude of the coordination that will be required to effectively share the 2 GHz BAS band. Moreover, the Commission's hopeful reliance on terrain shielding and antennas that are pointed out to sea offers little solace to those BAS licensees that do not operate near a mountain or an ocean.<sup>21</sup>

Therefore, the Joint Broadcasters commissioned a study designed to better quantify the universe of 2 GHz BAS licensees that would need to coordinate with each DoD facility.<sup>22</sup> This study first compared the coordination zones for each DoD earth station with the boundaries of all television DMAs in the vicinity.<sup>23</sup> Then, the study

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<sup>18</sup> *Id.* at 13252.

<sup>19</sup> *Id.*

<sup>20</sup> *Id.*

<sup>21</sup> Further undercutting this notion is the fact that TT&C facilities located near an ocean typically pick up a satellite over the ocean horizon and follow its arc up and overhead and down the other side, at which point the DoD systems may encounter BAS operations.

<sup>22</sup> *Engineering Statement Re: 2 GHz DoD Spectrum Sharing and BAS Coordination Analysis*, Cohen, Dippell and Everist, P.C. ("*2 GHz Overlap Study*"), attached hereto as Exhibit A.

<sup>23</sup> Coordination zones define areas where analysis needs to be done to determine whether harmful interference could occur. Five of the 11 DOD TT&C earth stations (Anderson AFB, Guam; Buckley Field, CO; Kaena Pt, HI; New Boston, NH; and Vandenberg AFB,

analyzed the Commission’s universal licensing system (“ULS”) database to identify all of the BAS facilities that fall within the coordination zone of each TT&C earth station. The results of the study indicated a surprisingly large number of BAS stations that would need to coordinate with each DoD earth station, and that some BAS licensees would need to coordinate with multiple TT&C earth stations. Table 1, below, sets forth the estimated number of licensees that would need to coordinate with each TT&C station.

**Table 1: Estimated Number of Potentially Affected BAS Licenses<sup>24</sup>**

<b>DoD Site</b>	<b>Number of Affected BAS Licensees</b>
Naval Satellite Control Network, Prospect Harbor, ME	56
New Hampshire Tracking Station, New Boston AFS, NH	115
Eastern Vehicle Checkout Facility & GPS Ground Antenna & Monitoring Station, Cape Canaveral, FL	85
Buckley AFB, CO	91
Colorado Tracking Station, Shriever AFB, CO	86
Kirtland AFB, NM	95
Camp Parks Communications Annex, Pleasanton, CA.	90
Naval Satellite Control Network, Laguna Peak, CA	88
Vandenberg Tracking Station, Vandenberg AFB, CA	86
Hawaii Tracking Station, Kaena Pt., Oahu, HI	15

Significant numbers of broadcast stations would have to engage in ongoing, proactive coordination with DoD to prevent interference, particularly in the northeast and southwest regions of the United States. For example, the coordination zone of the New Boston TT&C earth station encompasses most of New England and will require coordination by DoD with BAS stations in 14 different television DMAs from Boston all the way to New York City. Similarly, the coordination zone of the Vandenberg Tracking

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CA) have specific contours that are contained in Annex B of NTIA’s *Manual of Regulations and Procedures for Federal Radio Frequency Management* (May 2003 ed.). For the remaining 6 sites, the study used NTIA’s maximum allowable coordination radius of 362 statute miles, which we have rounded to 360 miles for simplicity.

<sup>24</sup> These numbers are estimated because the information in the Commission’s ULS licensing database is known to contain numerous errors, particularly with regard to BAS licenses. *See, e.g.*, Application for Review of The Society of Broadcasting Engineers, Inc. in ET Docket No. 01-75 (filed October 27, 2003).

Station in California overlaps eight television DMAs, including Los Angeles, San Francisco and San Diego. Further complicating matters is the need for BAS stations in southern and central California to coordinate with three different DoD earth stations (Camp Parks, Laguna Peak and Vandenburg), and for BAS stations in the Phoenix, Arizona DMA to coordinate with two different DoD facilities (Kirkland AFB, New Mexico, and Laguna Peak, California). Overall, DoD relocation will have a significant impact on many BAS licensees in large markets, including television stations in four of the top ten DMAs, and many others in 13 of the top 30 DMAs.<sup>25</sup>

All of these thorny situations, as well others set forth in the *2 GHz Overlap Study*, compel the Joint Broadcasters to disagree with the Commission's conclusion that relocation of the TT&C operations can be accomplished without a serious impact on incumbent BAS operations. To the contrary, we now believe that DoD relocation may have an unavoidable, detrimental effect on BAS systems that could severely compromise the level of local, on-the-spot news that consumers have come to expect from their local television stations.

#### **B. DoD Operations Will Likely Interfere With BAS Services**

Based on an examination of publicly available data and sound engineering principles, the Joint Broadcasters now believe that, as a practical matter, it will be impossible for the relocated DoD TT&C operations to fully avoid causing interference to BAS facilities.

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<sup>25</sup> These DMAs are: New York (1), Los Angeles (2), San Francisco (5), Boston (6), Tampa-St.Petersburg (13), Phoenix (15), Miami (17), Denver (18), Sacramento (19), Orlando (20), Portland, Oregon (24), San Diego (26), and Hartford/New Haven (27).

As mentioned above, NTIA has not yet responded to the Commission's request for detailed information concerning the interference potential of the 11 earth stations proposed for relocation to the 2 GHz BAS band.<sup>26</sup> The Joint Broadcasters therefore commissioned a second study designed to estimate this interference potential to the extent possible based on publicly available data.<sup>27</sup> The *2 GHz Interference Study* relies in part on public information about TT&C earth stations gleaned from a report prepared by DoD as part of an investigation into the feasibility of spectrum sharing among IMT 2000 systems (3G) and DoD facilities in the 1755–1850 MHz band,<sup>28</sup> including four of the 11 TT&C earth stations proposed for relocation to the 2 GHz BAS band.<sup>29</sup>

The analysis in the *2 GHz Interference Study* is based on several assumptions. First, the Commission is in the process of reducing the 2 GHz BAS band in size from 120 MHz (1190-2110 MHz) to 85 MHz (2025-2110 MHz) in order to accommodate MSS or other AWS services.<sup>30</sup> As part of this reallocation, BAS operations will need to transition to digital equipment. It is likely that by the time DoD is ready to relocate the 11 TT&C earth stations to the 2 GHz BAS band, the BAS reallocation and digital transition will be under way. Accordingly, the *2 GHz Interference Study* gauges the interference potential

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<sup>26</sup> Cf. *FCC Seeks Comment on the National Telecommunications and Information Administration's Report "An Assessment of the Viability of Accommodating Advanced Mobile Wireless (3G) Systems in the 1710-1770 MHz and 2110-2170 MHz Bands*, Public Notice, ET Docket No. 00-258 (rel. July 24, 2002).

<sup>27</sup> *Potential Interference from Relocated DoD SATOPS Earth Stations into BAS Receive Stations in Nearby Cities and Associated Future Coordination Issues*, Jeff Binckes Associates, LLC ("*2 GHz Interference Study*"), attached hereto as Exhibit B.

<sup>28</sup> *Department of Defense Investigation of the Feasibility of Accommodating the International Mobile Telecommunications (IMT) 2000 Within the 1755-1850 MHz Band*, February 9, 2001, at 5.7 ("*DoD IMT Report*").

<sup>29</sup> Specifically, the stations in New Boston, NH; Laguna Peak, CA, Kirkland AFB, NM, and Camp Parks, CA.

<sup>30</sup> See *supra* note 6.

between the DoD operations and BAS facilities based on the characteristics of digital BAS equipment.

Second, the study takes account of the fact that seven of the 11 TT&C earth stations slated for operation in the 2 GHz band are not yet built by presuming that the technical parameters of the new 11 DoD TT&C stations will be very similar to those of the four existing DoD TT&T systems. Finally, the Commission states that the new TT&C uplink transmitter output power is expected to range from 100 Watts to 10 kW.<sup>31</sup> The *DoD IMT Report* indicates that these stations typically operate between 100 and 2.5 kW power. The *2 GHz Interference Study* therefore assumes operation of the DoD TT&C systems at 100 Watts and 2.5 kW.<sup>32</sup> That assumption has the effect of reducing the level of potential interference.

The *2 GHz Interference Study* illustrates that, depending on the power output of a TT&C earth station, many of the DoD facilities slated for relocation to the 2 GHz BAS band will cause harmful interference to BAS systems. One overall principle revealed in the study is that, while low power TT&T operations (100 Watts) will not always cause interference to BAS facilities in the vicinity, high power TT&C operations (2.5 kW) will cause such harmful interference almost all of the time. For example, the study demonstrates that the 2 GHz BAS receive site in downtown Boston will experience interference from the TT&C facility at New Boston, New Hampshire only when the TT&C antenna is pointed at a low elevation angle (3 degrees above the horizon) and operating at a power of 2.5 kW. On the other hand, the BAS receive site located on Mt.

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<sup>31</sup> *Fourth Notice*, 18 FCC Rcd at 13254.

<sup>32</sup> Given the Commission's statement that the TT&C systems may operate at 10 kW in certain instances, the *2 GHz Interference Study* also addresses this situation at various points.

Uncanoonuc in Goffstown, New Hampshire will experience interference anytime the New Boston TT&C station is operational, and under certain circumstances, will be completely overloaded and therefore rendered useless.<sup>33</sup>

These are but a few examples of the interference problems that the DoD operations are likely to cause BAS systems. As mentioned, this analysis is based on assumptions derived from the known technical parameters of the four TT&C earth stations addressed in the *DoD IMT Report*. However, based on the assumption that these four stations are typical, the *2 GHz Interference Study* concludes that the seven other DoD earth stations bound for relocation also will cause harmful interference to nearby BAS receive much of the time.

### **C. DoD Operations Are Likely to Constrain BAS Services**

The Commission notes that federal government earth stations at 29 sites are authorized to transmit in the 2 GHz BAS band at the present time, in support of its belief that coordination will enable the additional 11 earth stations to successfully share the 2 GHz BAS band with BAS services.<sup>34</sup> Indeed, the Commission asserts that “the local BAS users should be able to *work around* the coordinated area[s].”<sup>35</sup> However, this uncorroborated logic is sound only if the new TT&C systems are technically and operationally identical, or at least very similar, to the existing DoD sites. Of course, there is no way to make this determination yet because NTIA has not provided the necessary data concerning the new earth stations.

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<sup>33</sup> In addition, as an aside, if the New Boston earth station operates at super high power (10 kW, 6 db higher than at 2.5 kW), it will cause harmful interference to all the BAS receive sites in the vicinity regardless of antenna angle or any other factors

<sup>34</sup> *Id.* at 13252.

<sup>35</sup> *Id.* at 13254 (emphasis added).

As the Commission is well aware, BAS represents a vital avenue for the delivery of breaking news and emergency information to the American public. In earlier comments, the Joint Broadcasters explained that local broadcasters already fully exploit their allotment of BAS channels in the 2 GHz BAS band all over the country. We noted that BAS is used for electronic newsgathering (“ENG”) to transmit live, on-the-spot news reports to local studios and in preparation for local newscasts. BAS is also used to transmit point-of-view camera transmissions that enhance coverage of special events, such as blimp shots during sporting events and shots from roving reporters along parade routes. In addition, studio-to-transmitter (“STL”) and inter-city (“ICR”) fixed links in the 2 GHz BAS band enable stations in less urban areas to relay programming from the station’s main studio to the transmitter facility or to deliver signals to remote communities.<sup>36</sup>

For example, BAS operations made possible the extensive, extraordinary coverage of the September 11 terrorist attacks. More recently, local stations have relied on BAS facilities to deliver potentially life-saving information about Hurricane Isabel and the widespread fires in California.

Furthermore, BAS services have increased over the last few years. For purposes of the MSS proceeding, the broadcasting industry recently collected and submitted data on the amount of BAS equipment owned and operated by local television stations nationwide.<sup>37</sup> The *2003 BAS Survey* revealed several unexpected and interesting changes concerning the breadth of use of BAS equipment. First, the *2003 BAS Survey* illustrates

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<sup>36</sup> *Joint Broadcasters MSS Comments* at 3.

<sup>37</sup> *2003 2 GHz Census & Digital Conversion Cost Estimate*, Ad Hoc 2 GHz Reallocation Committee, attached to Joint Broadcasters *ex parte* comments filed in ET Docket 00-258 on October 16, 28 and 31, 2003 (“*2003 BAS Survey*”), attached hereto as Exhibit C.

that use of BAS equipment is now fairly evenly distributed among television stations located in large, mid-sized and smaller-sized markets.<sup>38</sup> One explanation for this growth may be the introduction of many more local newscasts in the latter two categories, or the expansion of existing newscasts to deliver at-the-scene news coverage. Second, the *2003 BAS Survey* demonstrates an expanded use of BAS for STLs and ICRs. BAS fixed links have always been vital for local stations in relatively rural areas that relay their newscasts to distant viewers, but the survey also shows a marked increase of BAS fixed links in mid-sized and larger television DMAs.<sup>39</sup>

If nothing else, the *2003 BAS Survey* illustrates an ever-growing use and importance of BAS facilities to local broadcasters. These factors will only make it more difficult, as well as more critical, for the proposed TT&C earth stations to coordinate their operations in the 2 GHz BAS band. For example, as the *2 GHz Interference Study* shows, if the TT&C station at New Boston, NH operates at 10 kW, it would cause inference to most of the BAS receive sights used by local television stations in the Boston DMA. If this were to occur during a peak news hour such as 6:00-7:00pm time or during a breaking news event, the interference from the DoD systems might cause such a news story to be lost altogether.

Moreover, any attempts by the New Boston TT&C station to coordinate by notifying all the potentially affected BAS licensees in advance that the DoD earth station planned on operating at super high power during a certain time period would be little consolation during a breaking news story. In this event, broadcasters would face an

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<sup>38</sup> *2003 BAS Survey* at 4-5.

<sup>39</sup> *Id.* at 5.

unpleasant choice between covering the story with a corrupt news feed, or not covering the story at all.

Nevertheless, the Commission seems to have concluded that coordination will make it feasible for the 11 DoD TT&C earth station to share the 2 GHz BAS band with BAS systems.<sup>40</sup> The Commission also makes clear that the new TT&T facilities “shall not be permitted to constrain” the operation or deployment of BAS services, and that coordination will be required.<sup>41</sup> However, as a practical matter, the Joint Broadcasters fail to see how it will be possible to prevent or resolve many of the inevitable interference problems that will surely arise between the proposed DoD facilities and BAS operations. At best, there is simply not enough information available to make any accurate or worthwhile determinations. At worst, based on the *2 GHz Interference Study*, harmful interference from the TT&C systems to BAS facilities will be an inevitable, chronic occurrence.

### **III. CONCLUSION**

Based on currently available data, the Joint Broadcasters now must oppose the Commission’s proposed relocation of 11 DoD TT&C earth stations to the 2 GHz BAS band. It is possible, however, that, under certain conditions,<sup>42</sup> the Joint Broadcasters could change this conclusion. First, NTIA must disclose detailed information on the technical parameters of the new earth stations that enables the broadcaster industry to make a full and accurate assessment of the potential interference that the DoD operations

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<sup>40</sup> *Fourth Notice*, 18 FCC Rcd at 13252.

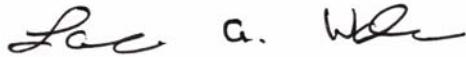
<sup>41</sup> *Id.* at 13249-250 quoting proposed revisions of footnote US346.

<sup>42</sup> We also reiterate our concerns that NTIA and the Commission not view the 2 GHz band as a dumping ground for a wholesale relocation of DoD systems. Any such relocation must be limited to a limited and finite number. *See Joint Broadcasters MSS Comments* at 8.

will have on BAS facilities. Second, based on that assessment, the broadcasting industry must be able to determine that successful coordination among DoD and BAS facilities is a realistic possibility. Finally, the Commission must place strict limits on the output power levels of the TT&T systems in order to limit the potential interference to the degree possible.

Respectfully submitted,

NATIONAL ASSOCIATION OF  
BROADCASTERS



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Henry L. Baumann  
Jack N. Goodman  
Larry Walke

Kelly Williams  
NAB Science and Technology

1771 N Street, NW  
Washington, DC 20036  
(202) 429-5430

ASSOCIATION FOR MAXIMUM SERVICE  
TELEVISION, INC.



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David L. Donovan  
Victor Tawil

4100 Wisconsin Avenue, N.W.  
Washington, D.C. 20016  
(202) 966-1956

Dated: November 3, 2003

ENGINEERING STATEMENT  
RE 2 GHZ DOD SPECTRUM SHARING AND  
BAS COORDINATION ANALYSIS  
FOURTH NOTICE OF PROPOSED RULE MAKING IN  
ET DOCKET NO. 00-58 AND WT DOCKET NO. 02-8  
ON BEHALF OF  
**NATIONAL ASSOCIATION OF BROADCASTERS**

OCTOBER 2003

COHEN, DIPPELL AND EVERIST, P.C.  
CONSULTING ENGINEERS  
RADIO AND TELEVISION  
WASHINGTON, D.C.

This engineering statement has been prepared on behalf of the National Association of Broadcasters (“NAB”). The purpose of this engineering statement is to identify the processes taken to complete the requests set forth in the proposal entitled, *2 GHz - DOD Spectrum Sharing Statement of Work*.

Briefly the following information is developed to assist in identification of all ULS entries that fall within the 2 GHz band and within the spacing distances specified of DOD facilities as indicated by the Notice of Proposed Rule Making.<sup>1</sup>

The following outlines the method by which relevant information was developed. Part 74 licenses and applications were obtained by downloading the Universal Licensing System’s (“ULS”) database from the FCC’s Wireless Division’s web page. A specially designed software program was developed using Structured Query Language (“SQL”) embedded with an algorithm used to calculate the distance between two sets of coordinates. Then all licenses and applications were selected from the database that were within the 1990-2110 MHz band and that fell within the DOD coordination zone, i.e., the calculated distance between the DOD site and the coordinates specified in the ULS database that was equal to or less than that of the specified radius. With the exception of the New Hampshire Tracking Station, New Boston AFS, NH and the Vandenberg Tracking Station, Vandenberg AFB, CA, the coordination zones were established relative to each specified site with

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<sup>1</sup>“In the Matter of Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems”, “Amendments to Parts 1, 2, 27 and 90 of the Commission’s Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands”.

a radius of 360 miles for the locations in Table I and the specified radii in Table II. The coordination zones of the Vandenberg and New Boston sites were created so as to duplicate the Coordination Contour for Transmitting Earth Station as defined in B-8 of Annex B entitled, *“Data and Procedures for Assessing Interactions Among Stations in the Space and Terrestrial Services”*.

The output from the SQL statements generated tables in Microsoft Excel for all licenses that fell within each specified coordination zone. The BAS information collected from the ULS database consisted of the microwave call sign, the geographic coordinates, the licensee name, the broadcast call sign, the facility identification number, the operating frequency and the status of the license. This information is tabulated in the same order as the listed Federal Government facility contained in Table 1 and Table 2. Each site on the table was plotted on a map with the Designated Market Areas (“DMA”) for 2001-2002 as defined by Nielsen Media Research. Each map is associated with the relevant Federal facility.

Ryan M. Felmlee, being duly sworn upon his oath, deposes and states that:

He is a graduate electrical engineer of The Pennsylvania State University and is a staff engineer at Cohen, Dippell and Everist, P.C., Consulting Engineers, Radio - Television, with offices at 1300 L Street, N.W., Suite 1100, Washington, D.C. 20005;

That the attached engineering report was prepared by him or under his supervision and direction and

That the facts stated herein are true of his own knowledge, except such facts as are stated to be on information and belief, and as to such facts he believes them to be true.

---

Ryan M. Felmlee  
District of Columbia

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 2003.

---

Notary Public

My Commission Expires: \_\_\_\_\_

**PLOTTED BAS/DOD SITES WITH 2001-2002 DMA**

360 MILE RADIUS

NAVAL SATELLITE CONTROL NETWORK  
PROSPECT HARBOR, MAINE

44° 24' 55" N  
68° 00' 50" W

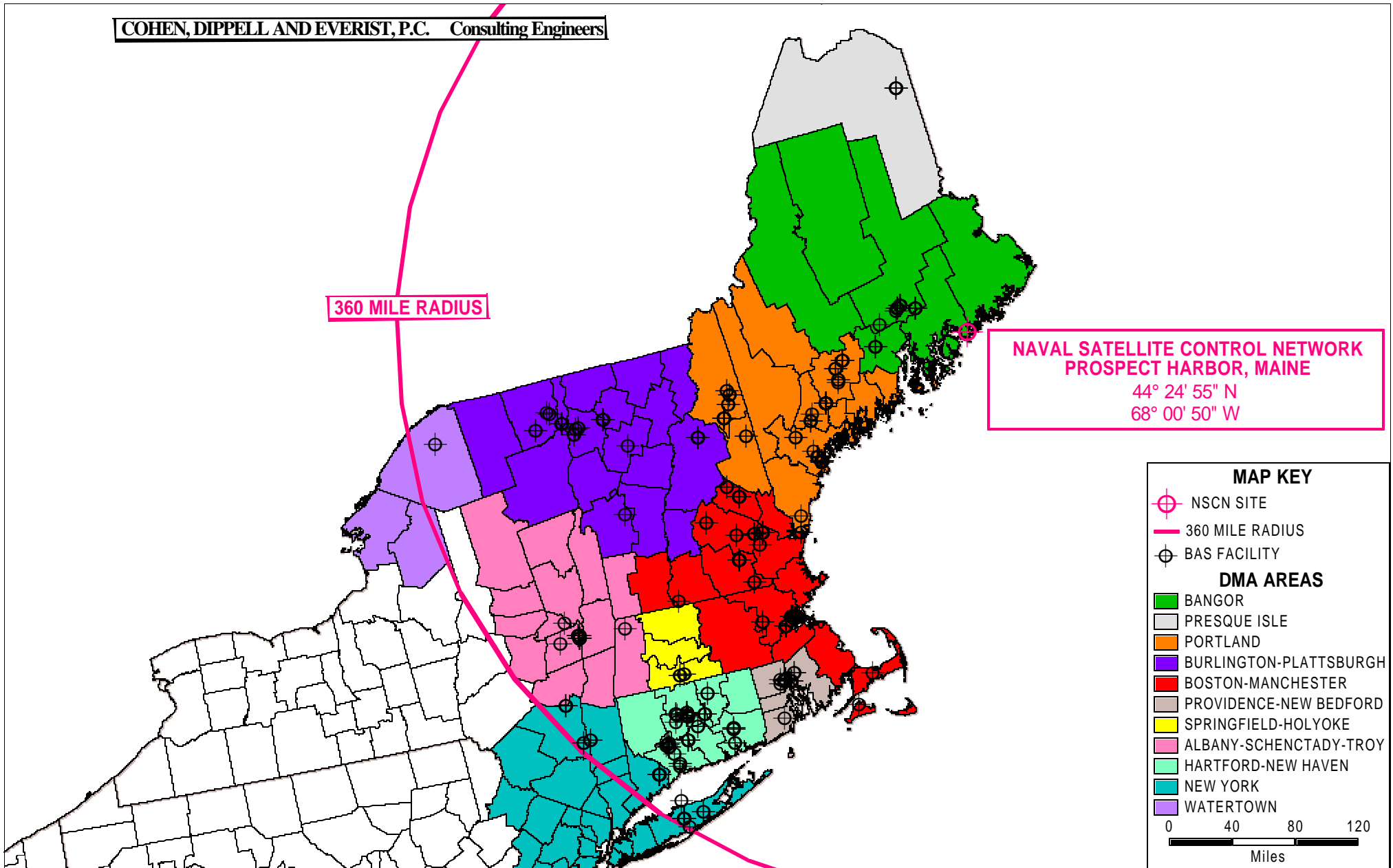
MAP KEY

- NSCN SITE
- 360 MILE RADIUS
- BAS FACILITY

DMA AREAS

- BANGOR
- PRESQUE ISLE
- PORTLAND
- BURLINGTON-PLATTSBURGH
- BOSTON-MANCHESTER
- PROVIDENCE-NEW BEDFORD
- SPRINGFIELD-HOLYOKE
- ALBANY-SCHENCTADY-TROY
- HARTFORD-NEW HAVEN
- NEW YORK
- WATERTOWN

0 40 80 120  
Miles



**NEW HAMPSHIRE TRACKING STATION  
NEW BOSTON AFS, NEW HAMPSHIRE**

42° 56' 52" N  
71° 37' 37" W















**NEW BOSTON AFS CONTOUR**

**MAP KEY**

 NHTS SITE

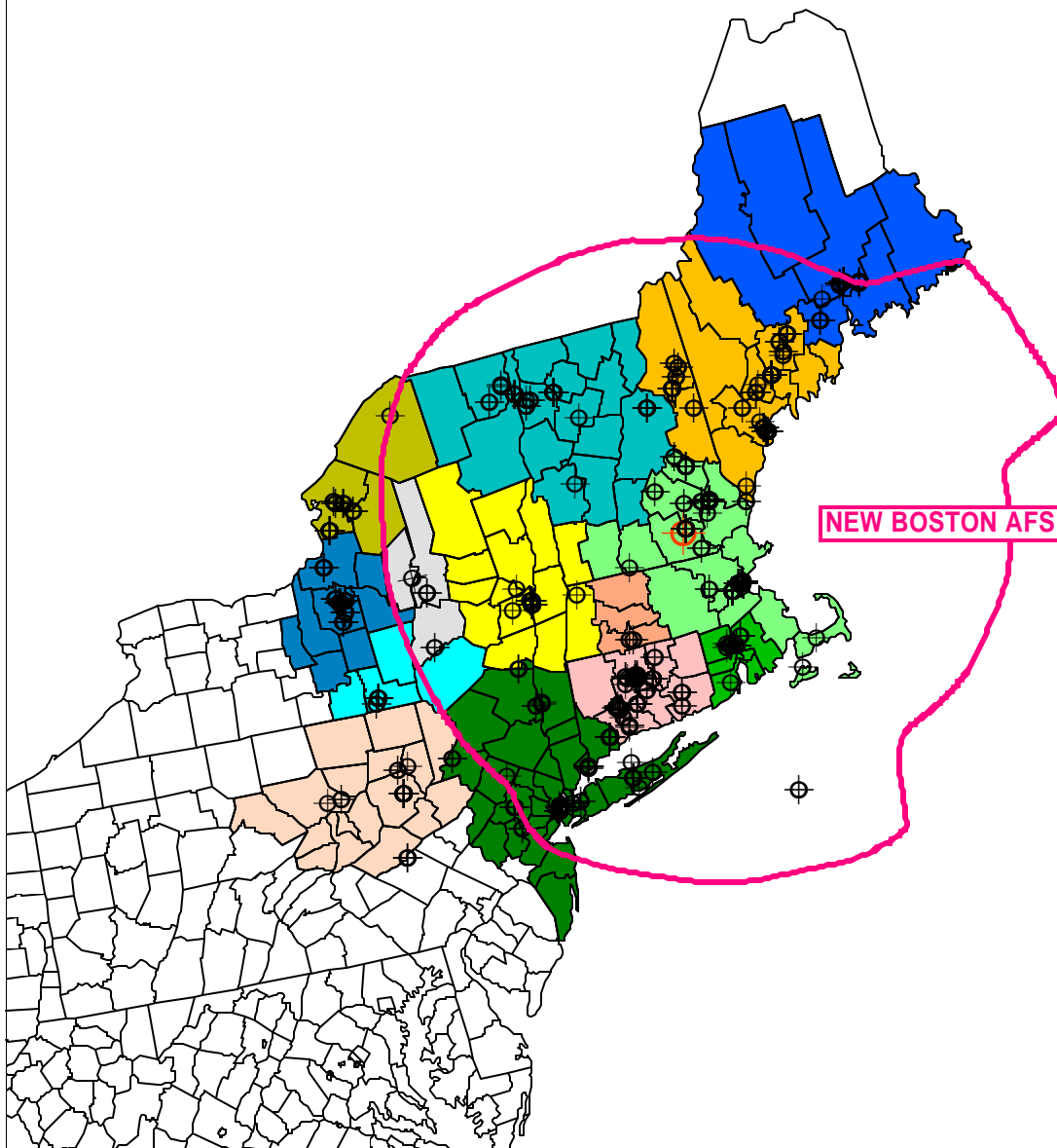
 NHTS SITE

**DMA AREAS**

-  BANGOR
-  PORTLAND-AUBURN
-  BURLINGTON-PLATSBURGH
-  BOSTON-MANCHESTER
-  PROVIDENCE-NEW BEDFORD
-  HARTFORD-NEW HAVEN
-  SPRINGFIELD-HOLYOKE
-  ALBANY-SCHENECTADY-TROY
-  BINGHAMTON
-  UTICA
-  WATERTOWN
-  SYRACUSE
-  NEW YORK CITY
-  WILKES BARRE-SCRANTON

0 100 200 300

Kilometers



COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

360 MILE RADIUS

EASTERN VEHICLE CHECK-OUT FACILITY  
AND GPS GROUND ANTENNA  
AND MONITORING STATION  
CAPE CANAVERAL, FLORIDA

28° 29' 10" N  
80° 34' 34" W

#### MAP KEY

CAPE CANAVERAL SITE

360 MILE RADIUS

BAS FACILITY

#### DMA AREAS

- JACKSONVILLE-BRUNSWICK
- MIAMI-FORT LAUDERDALE
- WEST PALM BEACH-FORT PIERCE
- TAMPA-ST. PETERSBURG-SARASOTA
- TALLAHASSEE-THOMASVILLE
- PANAMA CITY
- ORLANDO-DAYTONA BEACH-MELBOURNE
- GAINESVILLE
- FORT MYERS-NAPLES
- CHARLESTON
- SAVANNAH
- AUGUSTA
- MACON
- ALBANY
- DOTHAN
- COLUMBUS

0 80 160 240  
Kilometers

COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

BUCKLEY AFB, COLORADO

39° 42' 55" N  
104° 46' 29" W

360 MILE RADIUS

**MAP KEY**

- ⊕ BAS FACILITY
- ⊕ BUCKLEY AFB SITE
- 360 MILE RADIUS

**DMA AREAS**

- AMARILLO
- COLORADO SPRINGS
- ALBUQUERQUE
- WICHITA
- GRAND JUNCTION
- COLORADO
- LINCOLN
- CHEYENNE
- SALT LAKE CITY
- SIOUX FALLS
- CASPER
- RAPID CITY
- NORTH PLATE
- BILLINGS

0 100 200 300  
Kilometers

COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

**COLORADO TRACKING STATION  
SCHRIEVER AFB, COLORADO**

38° 48' 21" N  
104° 03' 43" W

360 MILE RADIUS

**MAP KEY**

- ⊕ BAS FACILITY
- 360 MILE RADIUS
- ⊕ SCHRIEVER AFB SITE

**DMA AREAS**

- WICHITA-HUTCHINSON
- ALBUQUERQUE-SANTA FE
- AMARILLO
- CASPER-RIVERTON
- CHEYENNE-SCOTTSBLUFF-STERLING
- COLORADO SPRINGS-PUEBLO
- GRAND JUNCTION
- LUBBOCK
- NORTH PLATTE
- LINCOLN-HASTINGS-KEARNEY
- DENVER
- SALT LAKE CITY
- RAPID CITY

0 100 200 300  
Kilometers

KIRTLAND AFB  
KIRTLAND, NEW MEXICO

35° 03' 00" N  
106° 24' 00" W

360 MILE RADIUS

MAP KEY

- ⊕ BAS FACILITY
- 360 MILE RADIUS
- ⊕ KIRTLAND AFB SITE

DMA AREAS

- WICHITA-HUTCHINSON
- TUCSON
- PHOENIX
- ODESSA-MIDLAND
- GRAND JUNCTION
- EL PASO
- DENVER
- ABILENE-SWEETWATER
- AMARILLO
- COLORADO SPRINGS-PUEBLO
- ALBUQUERQUE-SANTA FE
- LUBBOCK
- SALT LAKE CITY

0 100 200 300

Kilometers

CAMP PARKS COMMUNICATIONS ANNEX  
PLEASANTON, CALIFORNIA  
37° 44' 00" N  
121° 52' 00" W

360 MILE RADIUS

MAP KEY

- ⊕ BAS FACILITY
- 360 MILE RADIUS
- ⊕ CPCA SITE

DMA AREAS

- FRESNO-VISALIA
- LAS VEGAS
- MONTEREY-SALINAS
- SANTA BARBARA
- SAN FRANCISCO-OAKLAND-SAN JOSE
- LOS ANGELES
- BAKERSFIELD
- SACRAMENTO-STOCKTON-MODESTO
- CHICO-REDDING
- EUREKA
- RENO
- MEDFORD-KLAMATH FALLS
- EUGENE
- SALT LAKE CITY
- PORTLAND
- BOISE

0 70 140 210  
Miles

NAVAL SATELLITE CONTROL NETWORK  
LAGUNA PEAK, CALIFORNIA

34° 06' 55" N  
119° 04' 50" W

360 MILE RADIUS

MAP KEY

- ⊕ BAS FACILITY
- 360 MILE RADIUS
- ⊕ LAGUNA PEAK SITE

DMA AREAS

- FRESNO-VISALIA
- LAS VEGAS
- MONTEREY-SALINAS
- SAN DIEGO
- SANTA BARBARA
- SAN FRANCISCO-OAKLAND-SAN JOSE
- PHOENIX
- LOS ANGELES
- SACRAMENTO-STOCKTON-MODESTO
- BAKERSFIELD
- YUMA-EL CENTRO2
- PALM SPRINGS

0 70 140 210

Miles

VANDENBERG TRACKING STATION  
VANDENBERG AFB, CALIFORNIA

34° 49' 24" N  
120° 31' 54" W

VANDENBERG AFS CONTOUR

**MAP KEY**

⊕ VANDENBERG AFB SITE

⊕ BAS FACILITY

**DMA AREAS**

■ FRESNO-VISALIA

■ MONTEREY-SALINAS

■ SAN DIEGO

■ SANTA BARBARA

■ SAN FRANCISCO-OAKLAND-SAN JOSE

■ LOS ANGELES

■ SACRAMENTO-STOCKTON-MODESTO

■ BAKERSFIELD

0 100 200 300

Kilometers

HAWAII TRACKING STATION  
KAENA PT., OAHU, HAWAII

21° 33' 48" N  
158° 14' 54" W

360 MILE RADIUS

**MAP KEY**

— 360 MILE RADIUS

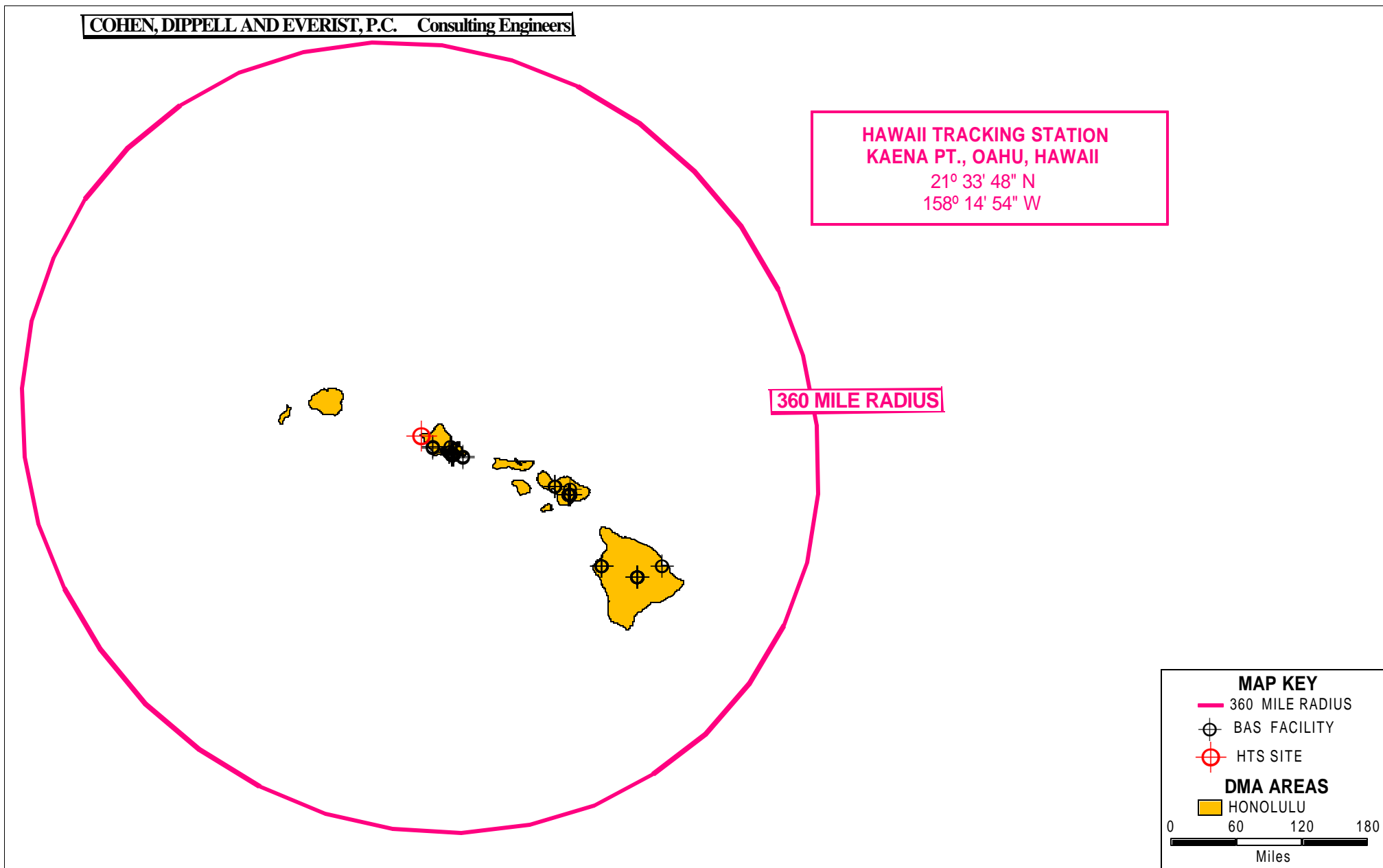
⊗ BAS FACILITY

⊗ HTS SITE

**DMA AREAS**

■ HONOLULU

0 60 120 180  
Miles



COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

NELLIS AFB, NEVADA

36° 14' 00" N  
115° 02' 00" W

80 KILOMETER RADIUS

CLARK

MOHAVE

**MAP KEY**

80 KILOMETER RADIUS

NELLIS AFB SITE

BAS FACILITY

**DMA AREAS**

LOS ANGELES

RENO

PHOENIX

0 10 20 30

Kilometers

COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

CHINA LAKE, CALIFORNIA

35° 41' 00"N

117° 41' 00"W

50 KILOMETER RADIUS


**MAP KEY**

 CHINA LAKE SITE

 50 KILOMETER RADIUS

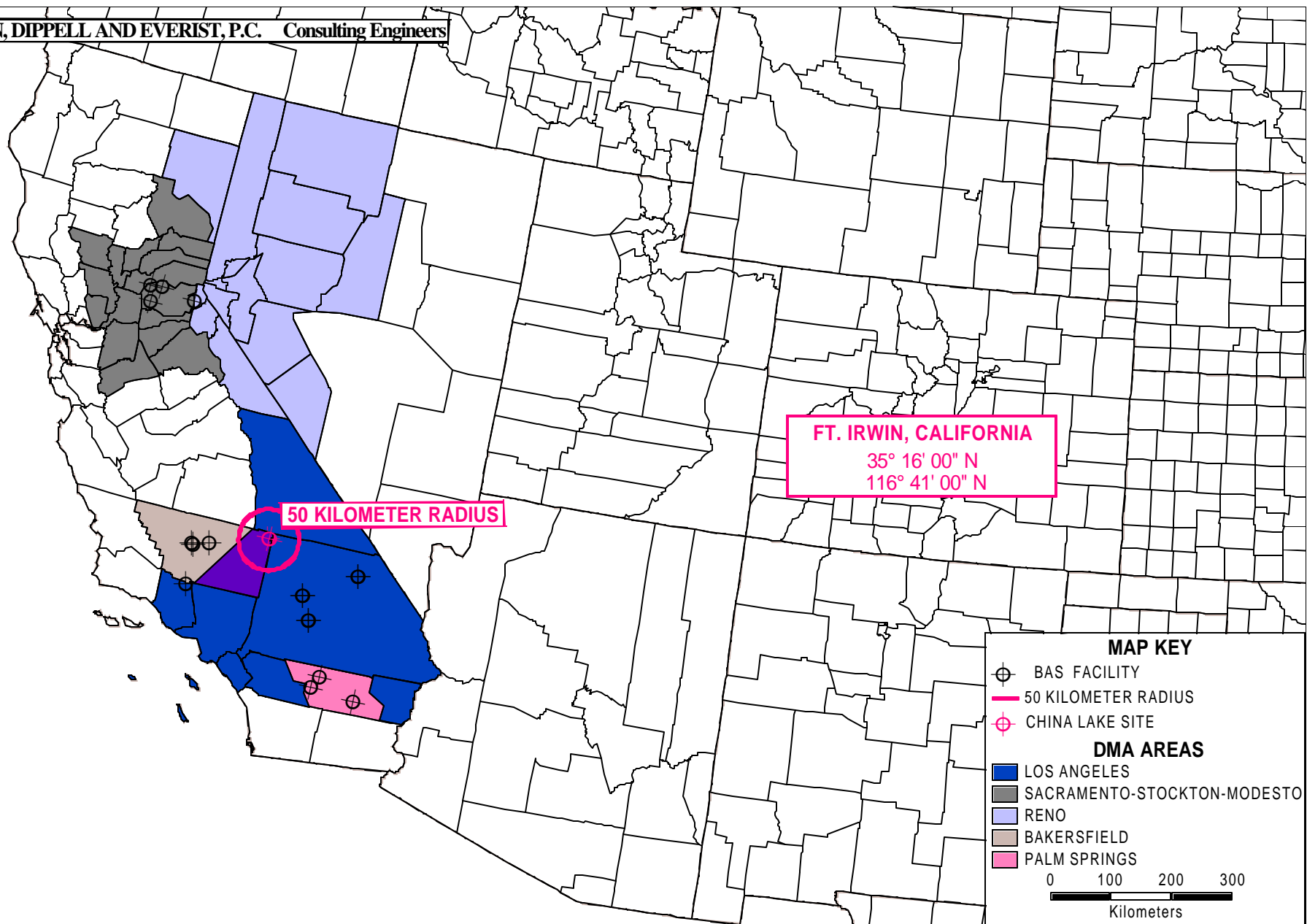
**DMA AREAS**

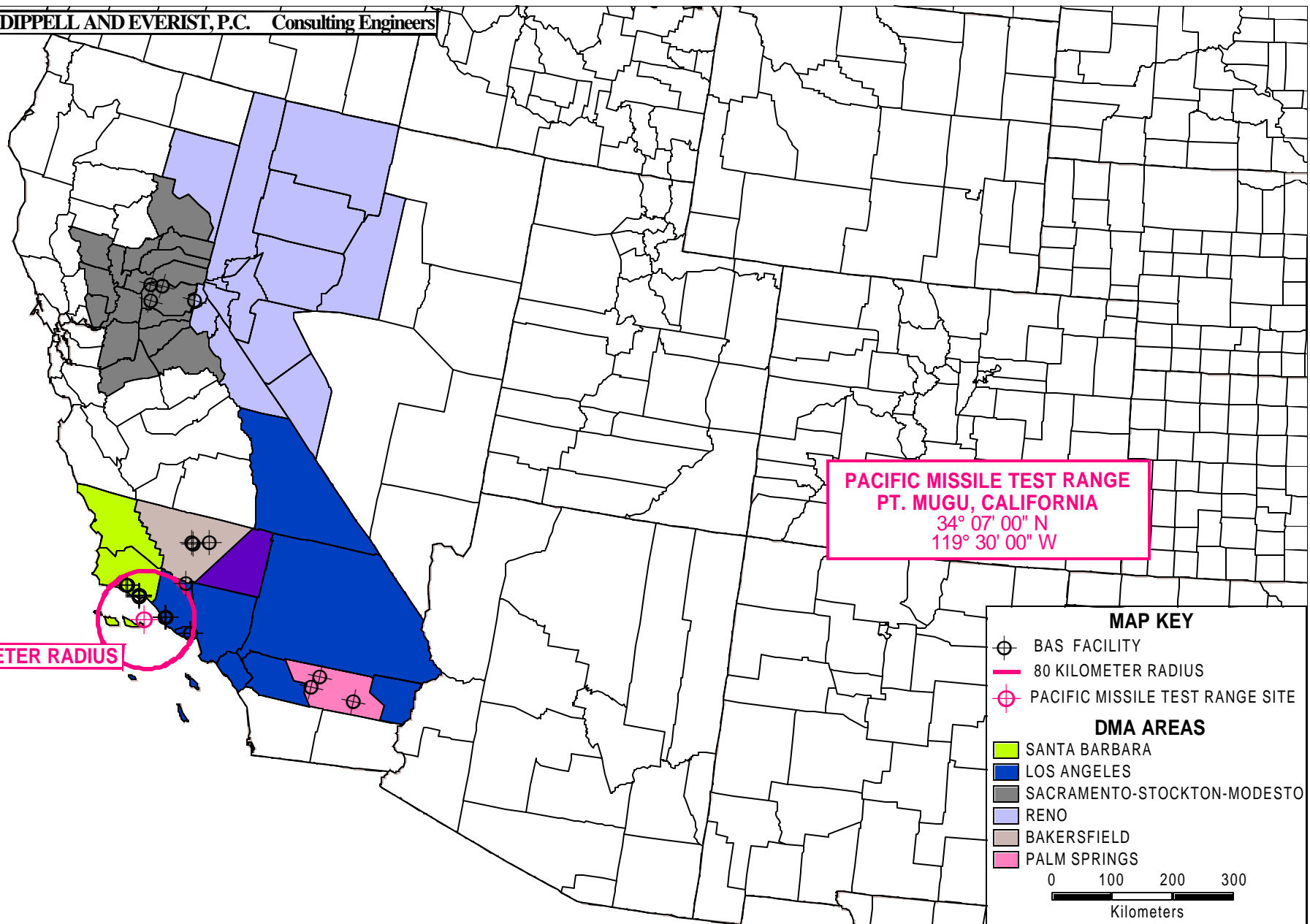
 FRESNO

 LOS ANGELES

0 8 16 24

Kilometers








COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

YUMA, ARIZONA  
32° 32' 00" N  
113° 58' 00" W




YUMA

80 KILOMETER RADIUS

**MAP KEY**

-  BAS FACILITY
-  YUMA, AZ SITE
-  80 KILOMETER RADIUS

**DMA AREAS**

-  YUMA/EL CENTRO
-  PHOENIX
-  TUCSON

0 10 20 30  
Kilometers

COHEN, DIPPELL AND EVERIST, P.C. Consulting Engineers

WHITE SANDS MISSILE RANGE, NEW MEXICO

33° 00' 00" N  
106° 30' 00" W

80 KILOMETER RADIUS

CHAVES

SIERRA

OTERO

DONA ANA

**MAP KEY**


 WHITE SANDS SITE

 80 KM RADIUS

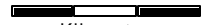
 BAS FACILITY

**DMA AREAS**

 EL PASO

 ALBUQUERQUE-SANTA FE

0 10 20 30

  
Kilometers

## TECHNICAL REPORT

### POTENTIAL INTERFERENCE FROM RELOCATED DoD SATOPS EARTH STATIONS INTO BAS RECEIVE STATIONS IN NEARBY CITIES AND ASSOCIATED FUTURE COORDINATION ISSUES

*JEFF BINCKES ASSOCIATES, LLC*

#### Executive Summary

This report provides technical analyses and insight into potential interference, which may result from the relocation of DoD earth stations, which now utilize the band 1761-1842 MHz—primarily for TT&C uplinks—into the band 2025-2110 MHz, the band now used by the Broadcast Auxiliary Service (BAS). The report underscores the need for a coordination mechanism to protect BAS receive sites from potentially harmful interference arising from the off-axis emissions (in the horizontal plane) emanating from side-lobes of large-diameter, high-power antennas tracking at low elevation angles above the horizon in support of military space operations, including TT&C for low earth orbit (LEO) and medium earth orbit (MEO) spacecraft.

This 85 MHz band segment mentioned above, has been identified in recent FCC Reports & Orders, as being the only spectrum remaining to BAS operations in the 2 GHz bands in the future; and, NTIA has stated that DoD will need to be granted access to this band: 2025-2110 MHz, on a co-equal, primary basis, as DoD relinquishes its TT&C operations in its present band 1761-1842 MHz. There are a total of 11 selected military reservation sites containing 1.7 GHz TT&C uplink earth stations that are currently support military satellite/space operations. Apparently, all these sites, according to the FCC's proposals in the *Fourth Notice of Proposed Rulemaking (NPRM)*, *ET Docket No. 00-258/WT Docket No. 02-8*, released July 7, 2003 (For example, see paragraphs No.15 & 21; and paragraphs 29-37, 4<sup>th</sup> NPRM) would be transferred from their present operations at 1.7 GHz to the 2 GHz band utilized by BAS. This raises the concern of potential interference from these uplink earth stations into BAS receivers located in cities that are relatively nearby the military bases in which the uplink earth stations are sited.

In the present study, interference paths from so called SATOPS (*SATellite OperationS*) earth stations into selected BAS receiver sites were analyzed using parameters from the present day SATOPS uplink earth stations (*See Department of Defense Investigation of the Feasibility of Accommodating the IMT-2000 Within the 1755-1850 MHz Band*, 9 February 2001, Appendix B.4.2 Technical Assessment or “DoD IMT-2000 Assessment”—for short). For purposes of this analysis, only four (4) of the earth station

sites and six (6) nearby BAS sites in nearby cities and towns were selected. The interference paths selected are laid out in Table 1 in the Section which follows.

The main idea in this report was to evaluate the range of expected, interfering power levels at the typical BAS receive sites, due to off-axis emissions from the four military earth stations. The receive locations selected are those in close proximity to the military bases. Analysis of the propagation losses between the earth station transmitters and the BAS receivers was performed using both free space losses and Over-the-Horizon, knife-edge diffraction, using real terrain profiles for the actual interference paths. These signal levels were then compared to the maximum allowable interference thresholds for receivers likely to be used by BAS in the future; i.e., digital receivers capable of supporting MPEG 4:2:2, compressed digital video with COFDM, using either QPSK or higher-order modulations such as 16 QAM.

The study clearly shows that some of selected BAS receive sites can coexist or continue to operate, un-degraded, with co-channel SATOPS uplink transmissions under certain, specific conditions; for example, when the earth stations transmit at minimum elevation angles above 5 degrees, using near minimum transmit powers of 100 watts or so. But the study also shows that there are likely to be high levels of *undesirable* interference to some BAS receivers when these same earth stations transmit at or near their maximum transmitter powers (typically 1kW to 2.5 kW or even as high as 7-10kW at some sites) and use this higher transmit power at minimum elevations angles down to 3 degrees.

Because of these findings, the report concludes there is a need for effective coordination between SATOPS uplink earth station operations and the nearby BAS receive sites. The report examines some alternative methods of improving the chances for successful coordination between SATOPS and BAS, especially in view of the fact that the 2 GHz *version* of SATOPS earth stations have yet to be built; and, therefore opportunities exist to enhance and simplify the required coordination by improving the design of the SATOPS earth stations (compared to present-day SATOPS) and giving intelligent consideration to optimizing the placement of the SATOPS sites on the military bases—while DoD is still in the planning stage for relocation of their earth stations from 1.7 GHz to 2 GHz.

### **Interference Analysis: Methodology and Signal Parameters Used**

In order to assess the potential for interference from selected SATOPS earth stations to representative BAS receive sites, parameters for the earth stations operating in the 2 GHz band—in the future—were assumed to be comparable to the parameters of the existing SATOPS earth stations operating in the 1.7 GHz band (1761-1842 MHz). These existing parameters were taken from the *DoD IMT-2000 Assessment*, and there are actually a range of parameters to be chosen, since the earth stations vary from 23-ft., 33-ft., 46-ft., and in a few cases up to 60-ft. in diameter. However, to simplify the calculations, the 46-ft. diameter dish was selected as the nominal, representative size for SATOPS in this analysis. The locations included in this analysis are shown below in Table 1. In some instances small discrepancies were noted between the latitude/longitude coordinates of

the DoD transmitting earth stations listed in the FCC's 4<sup>th</sup> NPRM and the coordinates for the same uplink earth stations given in the *DoD IMT-2000 Assessment*. The coordinates selected were those that seemed to be, on reference to computer generated maps, the most appropriate locations for the antennas on the military bases. In some cases a particular earth station's location was *not* given in the *DoD IMT-2000 Assessment*; and, therefore the coordinates listed in the FCC's 4<sup>th</sup> NPRM was used, since no cross check with information from the military was available in those cases.

**Table 1 SATOPS Uplink Sites Used in this Analysis**

<b>DoD Facility Uplink Earth Station Site</b>	<b>Location</b>	<b>Coordinates: Latitude/Longitude</b>	<b>Test BAS Receiver Site Used to Assess Interference</b>
New Hampshire Tracking Station New Boston AFS ("NHS")	Manchester, New Hampshire Antenna Center At 722.5-ft. AMSL	42-56-52.0N 71-37-37.0W	Downtown Boston (One Boston Pl) 42-21-31.3N 71-03-29.1W Rcv Antenna At 681.1-ft AMSL
NH Tracking Station NHS	Manchester, NH Antenna Center At 722.5-ft. AMSL	Same as above Coordinates	Goffstown, NH (Mountain top) 42-58-59.0N 71-35-17.0W Rcv Antenna At 1320-ft. AMSL
NH Tracking Station NHS	Manchester, NH Antenna Center At 722.5-ft. AMSL	Same as above Coordinates	John Hancock Bldg 42-20-55.3N 71-04-33.1W Rcv Antenna At 860-ft. AMSL
Naval Satellite Control Network, Laguna Peak, CA	Laguna Peak, LA Antenna Center At 45.1-ft. AMSL	34-06-55.0N 119-05-50.0W	Los Angeles (near LAX Airport) 33-50-00.0N 118-20-30.0W Rcv Antenna Height At 206.2-ft AMSL
Kirkland AFB	Kirkland AFB, New Mexico Antenna Center At 6808.7-ft AMSL	35-03-00.0N 106-24-00.0N	Santee Fe, NM Downtown Area 35-51-10.0N 106-15-25.0W Antenna Height At 7306.1-ft. AMSL
Camp Parks Communications Annex/Onizuka Air Station	Sunnyvale, CA. Antenna Center At 545.1-ft. AMSL	37-44-00.0N 121-52-00.0W	San Francisco/Oakland (at SUTRO Tower) 37-45-18.8N 122-27-09.9W

			Antenna Height At 1334.1-ft. AMSL
--	--	--	--------------------------------------

Signal levels at the BAS receive sites were calculated quasi-parametrically, based on the horizon, off-axis antenna gain of the DoD SATOPS earth stations transmitting at minimum elevation angles of: 1) 3 degrees above the horizon; and 2) 5 degrees above the horizon. Also, we used an average minimum transmit power of 100 Watts at the antenna feed for both elevation angles and a maximum or peak transmit power of 2.5 kW (there a few uplink earth stations with 46-ft or 60-ft. antennas capable of 7-10 kW peak power)—for both elevation angles to obtain the EIRPs radiated (in dBm) towards the horizon. Finally, for realistic path calculations the path losses were computed using a very accurate terrain-profile model to account for knife edge diffraction by terrain feature blockages along the path (247 points) as well as the usual free space, inverse-square losses. The 20% diffraction, controlling propagation mode was used to extract the terrain losses applicable to long-term interference at the BAS receive sites (signal levels seen for 20% of the time), as opposed to short-term interference calculations, which generally employ 0.01% criterion and for which the terrain losses would be somewhat lower.

Thus, to obtain the interfering power levels at a given BAS receiver, the Over-Horizon (OH) terrain losses were added to the free space losses to obtain the total long-term attenuation in the interference path between SATOPS and BAS. The EIRP radiated towards the horizon, minus this total attenuation in the path, plus a nominal BAS receive site antenna gain yields the signal levels seen at the input of the typical BAS receiver.

The range of EIRPs from the DoD earth stations is summarized below in Table 2, which covers the minimum to peak transmitter power; and, the antenna off-axis gain towards the horizon, when the dish is pointed at either 3-degrees or 5-degrees above the horizon.

**Table 2 SATOPS EIRP Radiated Towards Horizon (46-ft Antenna)**

<b>Gain at 3-degrees Minimum Elevation Angle 100 Watts TX Power</b>	<b>Gain at 3-degrees Minimum Elevation Angle 2.5 kW TX Power</b>	<b>Gain at 5-degrees Minimum Elevation Angle 100 Watts TX Power</b>	<b>Gain at 5-degrees Minimum Elevation Angle 2.5 kW TX Power</b>
+18 dBi	+18 dBi	+5 dBi	+5 dBi
+20 dBW	+34 dBW	+20 dBW	+34 dBW
+38 dBW	+52 dBW	+25 dBW	+39 dBW
+30 (re dBm)	+30 (re dBm)	+30 (re dBm)	+30 (re dBm)
+68 dBm Net	+82 dBm Net	+55 dBm Net	+69 dBm Net

As shown, for either the 3 degrees or 5 degrees minimum elevation angles, the EIRPs can vary over a 14 dB (25-fold) range. However, the EIRP radiated toward the horizon, considering DoD earth station operations at the lower or higher elevation angle and going from minimum transmit power of 100 Watts to peak transmit of 2.5 kW, can vary from a “low” of +55 dBm to a “high” of +82 dBm—a range of 27 dB or a 500-fold power range.

The full impact of these DoD uplink earth station operations can be then be assessed by addressing these EIRPs radiated towards the horizon, subtracting the free space PLUS terrain blockage losses, and adding a nominal +10 dBi for a quasi-omni directional receive antenna (e.g., MRC's "OmniPole" antenna for central receive systems, has a published performance of +8 to +11 dBi gain). Finally, the interference threshold for BAS digital receivers, utilizing COFDM to transmit MPEG 4:2:2 DVB-T compressed digital video, assuming co-channel operations with the DoD SATOPS signals, must be given consideration to determine whether degradation will occur with the range of expected signal levels from SATOPS. In summary, the interference paths *from* SATOPS earth stations *to* BAS receive sites are all calculated by:

$$I = P_T + G_T - (FSL + L_{TER}) + G_R$$

**Where  $I$**  = the power of SATOPS interference at the input of the BAS Receiver

**$P_T$**  = the SATOPS transmitter power at the SATOPS earth station antenna feed

**$G_T$**  = the SATOPS earth station antenna gain (off-axis) towards the horizon

**$FSL$**  = the free space losses on a line of sight ray, neglecting terrain blockage

**$L_{TER}$**  = the terrain dependent path losses, including knife edge diffraction (20%)

**$G_R$**  = the BAS receiver (Central receiver) gain in the direction of SATOPS

(assumed to be nominally +10 dBi for quasi-omni-directional antenna)

According to one manufacturer of BAS digital radios [MRC], it was determined that most receivers for digital-video applications will support a maximum input level of -25 dBm without crossing the compression point and causing cross-modulation distortion. However, the desired levels of tolerable interference are much, much lower than that; and, are a function of the COFDM demodulation format and the FEC code rate employed. For the typical Digital-ENG operations, the modulation mode that has been—and likely will be—employed on BAS/ENG shots, is QPSK, Rate ½ FEC Coding and 1/8<sup>th</sup> Guard Band (Throughput Bit rate of 5.53 Mbits/s). This mode of operation requires a C/N of about 7.4 dB with a resulting maximum allowable interference input receive carrier level of -71.5 dBm. However, it is possible that, in the future, some BAS operations may use HDTV and correspondingly higher transmissions rates using, say 64-QAM, Rate 7/8ths FEC coding and data rates approaching 29 to 31 Mbits/s—requiring a C/N of nearly 30 dB; or about 22.5 dB higher than that required for QPSK. For this most demanding case, the maximum interference at the BAS receiver input should not exceed a level of -94 dBm so as not to degrade the overall availability of a COFDM BAS shot using the 64-QAM high order modulation and the high bit-rate transmission.

## Results of Interference Analysis

The results of using the SATOPS transmit EIRPs/side-lobe antenna gains shown above in Table 2, as well as the SATOPS sites and Test BAS Receiver Sites given in Table 1, are summarized below in Table 3. It can be seen that in most cases a -71.5 dBm interference limit can be met with either earth station elevation angle. The more stringent limit of -94 dBm really requires the higher minimum elevation angle of 5-degrees. However, for the short-range case of Manchester, NH, earth station with an interference path to nearby

Goffstown, NH, mountain-top BAS receive site, the interference would clearly not only exceed the desirable limits, even for the less demanding QPSK video transmissions, but the interference, with 3-degree elevation angle and peak power of 2.5 kW would be exceeding the compression point of a typical central receiver (-25 dBm compression point), causing the receiver to over-load.

Also, in two of the cases, New Hampshire Tracking Station interference into the John Hancock Building, in Boston; and, Camp Parks earth station interference at SUTRO Tower, in San Francisco, the interference at the BAS receiver sites would be within a couple of decibels of the more sensitive limit of -94 dBm—which represents high bit-rate digital video using higher modulation, such as 64-QAM—when the earth stations are transmitting at 3 degrees elevation and using peak power of 2.5 kW. In two other cases, New Hampshire Tracking Station interference into another downtown Boston BAS site (One Boston Place); and, Kirkland AFB interference into downtown Santa Fe BAS site, the interference would clearly breach the more sensitive -94 dBm limit—at 3 degrees.

One should also bear in mind that, as mentioned in the FCC's 4<sup>th</sup> NPRM, several of the DoD uplink earth stations are capable of transmitting at peak powers of up to 10 kW. If those maximum 10 kW transmitter powers were employed at the earth stations analyzed here, the interference would be 6 dB higher than the levels indicated in this analysis, where it was assumed the peak power at the SATOPS earth stations would to be 2.5 kW. This higher level of transmitter power would certainly—in almost every test case indicated here—result in the -94 dBm interference criterion being breeched when the earth station operates at elevations down to 3 degrees.

This data suggests that, as a minimum, DoD SATOPS operations should accept a minimum elevation limit of 5 degrees, instead of the 3 degrees suggested by the FCC and NTIA in the 4<sup>th</sup> NPRM.

**Table 3**  
**Range of Expected Interference Levels From SATOPS Earth Stations At Selected BAS Receive Sites**  
**in Nearby Cities and Towns**

<b>Case</b>	<b>DoD Earth Station</b>	<b>Test BAS Receiver Site</b>	<b>Path Length (km)</b>	<b>Free Space Loss (dB)</b>	<b>Terrain Losses (dB)</b>	<b>Total Path Loss (dB)</b>	<b>3-Deg Low/High RFI Signal Levels (dBm)</b>	<b>5-Deg Low/High RFI Signal Levels (dBm)</b>	<b>Exceeds RFI Limits At BAS Site?</b>
<b>1A</b>	New H NHS	Downtown Boston	80.4	136.8	44.0	180.8	-102.8 / -88.8	-115.8/ -101.8	3-Deg exceeds w. High Power
<b>1B</b>	New H NHS	Goffstown NH	5.04	112.7	0.0	112.7	-34.7/ -20.7	-47.7/ -33.7	Yes, All Cases; w.3-Deg & High Power, overloads Receiver
<b>1C</b>	New H NHS	J.Hancock Bldg Boston	80.4	136.8	50.8	187.6	-109.6/ -95.6	-122.6/ -108.6	None, but close w. 3-Deg & High Power
<b>2</b>	Navy Satcom Laguna	Los Angeles Near LAX	75.1	136.2	60.0	196.2	-118.2/ -104.2	-131.2/ -107.2	None
<b>3</b>	Kirkland NM AFB	Downtown Santa Fe	90.0	137.8	36.0	173.8	-95.8/ -81.8	-108.8/ -94.8	3-Deg exceeds w. High Power
<b>4</b>	Camp Parks	San Fran At SUTRO Tower	51.7	133.0	56.3	189.3	-111.3/ -97.3	-124.3/ -110.3	None, but 3-Deg w. High Power within 3 dB of Limit

## Thoughts Concerning Coordination of SATOPS with BAS Receive Sites

Based upon the results of this limited set of Test BAS receive sites with 4 selected SATOPS uplink earth stations, it is apparent that in many cases some additional signal attenuation will be required if coordination between the earth stations and BAS receive sites is to be successful.

Since the 2 GHz version of the SATOPS earth stations have yet to be built, it is realistic to consider a range of options for DoD to consider *NOW*, while in the planning stages for relocation of these antennas from 1.7 GHz to 2 GHz, prior to site preparation and construction of the new earth stations. These options might include the following:

1. Incorporation of improved feed horns (corrugated feed-horns, low side-lobe) to reduce off-axis energy in the direction of the horizon;
2. Restrict SATOPS minimum elevation angle to 5 degrees versus 3 degrees in order to reduce off-axis gain in the direction of the horizon;
3. Earth stations use site shielding and/or edge-of-dish spill-over shields;
4. SATOPS accept peak transmit power to something less than 10 kW; use minimum transmitter power needed to close the link, except during contingencies or high-power testing of HPAs;
5. Consider some discipline on hours of high-power/test operations in order to avoid the peak busy hours of BAS receive site operations;
6. During relocation planning for the transition from 1.7 GHz to 2 GHz consider doing extensive site surveys in order to locate real estate on military bases (to site the new 2 GHz earth stations) that can take advantage of natural terrain blockage in the direction of the most vulnerable BAS receive sites located in the vicinity of the bases.

## **Affidavit**

I, Jeffrey B. Binckes, declare under penalty of perjury, that the attached engineering report prepared by me, on behalf of National Association of Broadcasters (NAB) is true and correct to the best of my knowledge, based upon analysis I performed using inputs and technical parameters received from NAB and documentation I obtained from DoD, NTIA, and the FCC.

I hold a Bachelor of Science (BS) Degree in Theoretical Physics, from Miami (Ohio) University and have had extensive training and practical experience in the satellite communications field, over a period of more than 35 years, including design of satellite payloads, earth stations, and transmission system engineering—for both analog and digital links—and coordination of earth stations with microwave stations sharing the same band(s).

Jeffrey B. Binckes

*Jeff Binckes Associates, LLC  
3614 Spruell Drive  
Silver Spring, MD. 20902-2337*

## **EXHIBIT C**

# **Ad Hoc 2 GHz Reallocation Committee**

## **2003 2 GHz BAS Census & Digital Conversion Cost Estimate**

### **Executive Summary**

This report describes the results of survey conducted by the Ad Hoc 2 GHz Reallocation Committee (the “Committee”) to determine the total population of 2 GHz transmitters and receivers in use at television stations in the United States and the cost to convert them to digital operation.<sup>1</sup> The survey referred to by the Committee as the 2003 2 GHz BAS Census (the “Census”), was conducted on-line from September 22 through 30, 2003. 437 full power television stations in Nielson Designated Market Areas (“DMAs”) 1-200 responded to the survey.<sup>2</sup>

The survey found that the average full power television station has approximately six (6) 2 GHz transmitters and four (4) 2 GHz receivers, with the numbers increasing to an average of fourteen (14) transmitters and nine (9) receivers in the top 10 markets. The survey also found that less than 5% of mobile transmitters of the type used in an Electronic News Gathering (“ENG”) vehicle were found to be digitally capable in DMAs 1-200, with the numbers only modestly increasing to 10% in the top 10 markets.

Using the aforementioned survey data, and by applying industry derived hard and soft cost estimates, an overall cost for transitioning 2 GHz ENG services in DMAs 1-210 to digital operation was projected at approximately \$397 million.<sup>3</sup>

The digital transition cost for the 655 2 GHz fixed links reported by survey respondents is estimated at \$65 million. The total projected fixed link cost may be at least \$115 million, based on the number of links contained in the FCC Universal Licensing Systems (ULS) database. However, it is believed that this number may underestimate the actual cost because it does not take into account circumstances where a link may need to relocate entirely to another band.

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<sup>1</sup> The analysis focuses primarily on the costs associated with ENG equipment changes by local over-the-air broadcast facilities. Other ENG users such as Local Television Transmission Service (LTTS) and Low Power Television Station (LPTV) licensees, television networks, and cable entities responded to the survey. For example while the costs to network owned and operated stations are included in the analysis, the separate costs attributable to the networks themselves may approach \$7-10 million.

<sup>2</sup> There are actually 210 DMAs, but no responses were received above the 200<sup>th</sup> DMA.

<sup>3</sup> These amounts do not include any costs already incurred by stations prior to the survey.

## Introduction

The Ad Hoc 2 GHz Reallocation Committee is a group of individuals interested in the issues associated with the ultimate relocation of incumbent broadcasters out of TV Broadcast Auxiliary Services (“BAS”) Channels A1 and A2 (1,990–2,018 MHz and 2,018–2,025 MHz). These relocations are the result of Commission actions in July 2000 which allocated this spectrum to the Mobile Satellite Service (“MSS”).<sup>4</sup> The Committee’s membership includes private individuals as well as representatives of broadcast stations, broadcast groups, industry trade organizations, and equipment manufacturers.<sup>5</sup>

The Committee’s primary activity has been to function as a clearinghouse for information about BAS relocation issues. Among the issues discussed by the members of the Committee have been the impact of proposed band plans that involve the use of reduced bandwidth or narrower channels by broadcasters, how television markets transition to such band plans, and the impact of having different band plans in adjacent markets. All these areas of course can be summed into one fundamental goal, ensuring that existing ENG and fixed link capabilities are retained during and after a transition.

## Survey Scope

The 2003 2 GHz Census was conducted in response to discussions with FCC staff members. The intention of the Census, herein referred to as the “Survey,” was to provide the broadcast industry and the FCC more data on the amount of electronic newsgathering and fixed link 2 GHz equipment in use at broadcast stations and how it was used. It was believed such information was essential to properly consider any proposed transition plan for clearing channels 1 and 2 in order to accommodate non-broadcast related users. This information would be used to help determine how much equipment needs replacement at each step in a transition plan, and estimate how much that equipment would cost. It could also be used to help analyze whether operation on differing band plans in adjacent markets was viable.

Members of the Committee developed a Web based survey form and database.<sup>6</sup> The Web based survey was fielded from September 22<sup>nd</sup> through the 30<sup>th</sup>, and the broadcast industry was alerted to its existence through direct email notification from the chairman of the Committee to the engineering managers for over 25 different broadcast groups.<sup>7</sup> It was also publicized by newsletters and emails from NAB, MSTV, SBE’s Volunteer

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<sup>4</sup> While the FCC’s rules creating the MSS service provide for the reimbursement of incumbent broadcasters for costs associated with the displacement of their 2 GHz operations, it should be noted that the Committee itself does not participate in any negotiation activity with MSS providers or other entities that may eventually use this spectrum, and strictly discourages activity that could be construed as such.

<sup>5</sup> While many of the individual committee members are also members of the Society of Broadcast Engineers (“SBE”), the SBE’s role in this issue is generally limited to facilitating communications among the Committee’s members and to planning for meeting space.

<sup>6</sup> A copy of the survey form itself is attached as Appendix A.

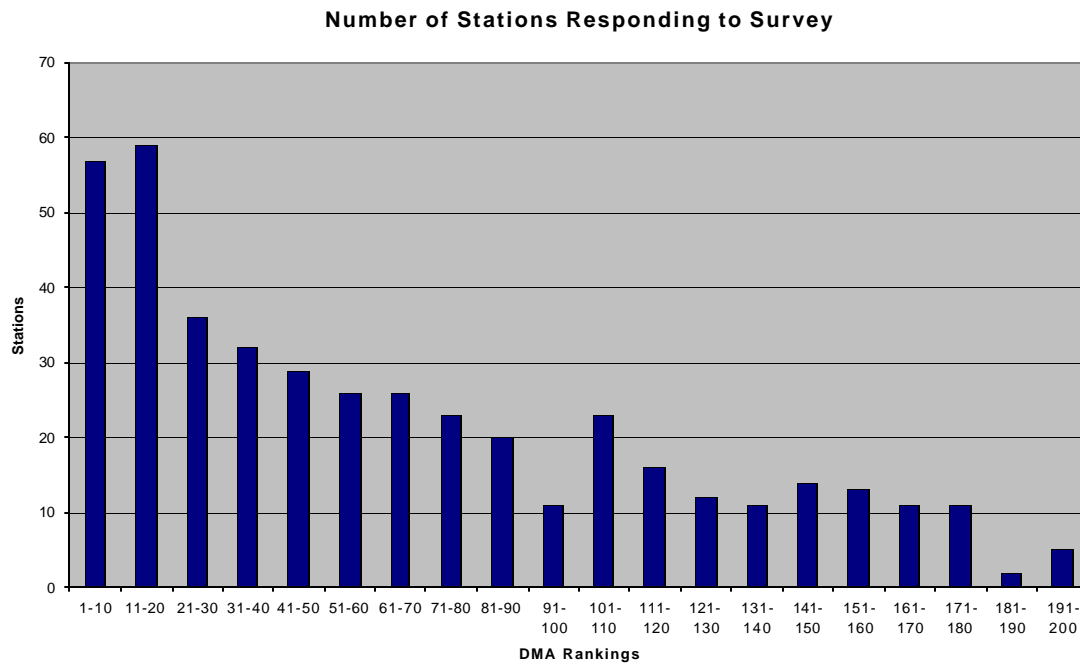
<sup>7</sup> Stations were also assured that individual station specifics would not be made available to the public.

Frequency Coordinators, and in RF technology newsletters published by *TV Technology* and *Broadcast Engineering* magazines.

## Survey Participation

Over 500 responses were received to the Survey. Of these responses 437 were from full power television stations in DMAs 1-200.<sup>8</sup> The distribution of responses across DMA groupings is illustrated in Figure 1. This response compares to a total number of 1643 full power stations licensed in these DMAs, or roughly a 27% participation rate overall. It must be pointed out that stations responding were by and large those that routinely used 2 GHz, with less than 8% of television station respondents indicating they had no equipment whatsoever.

Figure 1



<sup>8</sup> The remaining responses represented a mixture of duplicates, state and national networks, cable entities, low power stations, and television stations licensed in Puerto Rico. These responses are not considered in this report, although they are illustrative that there are many other users of the 2 GHz band.

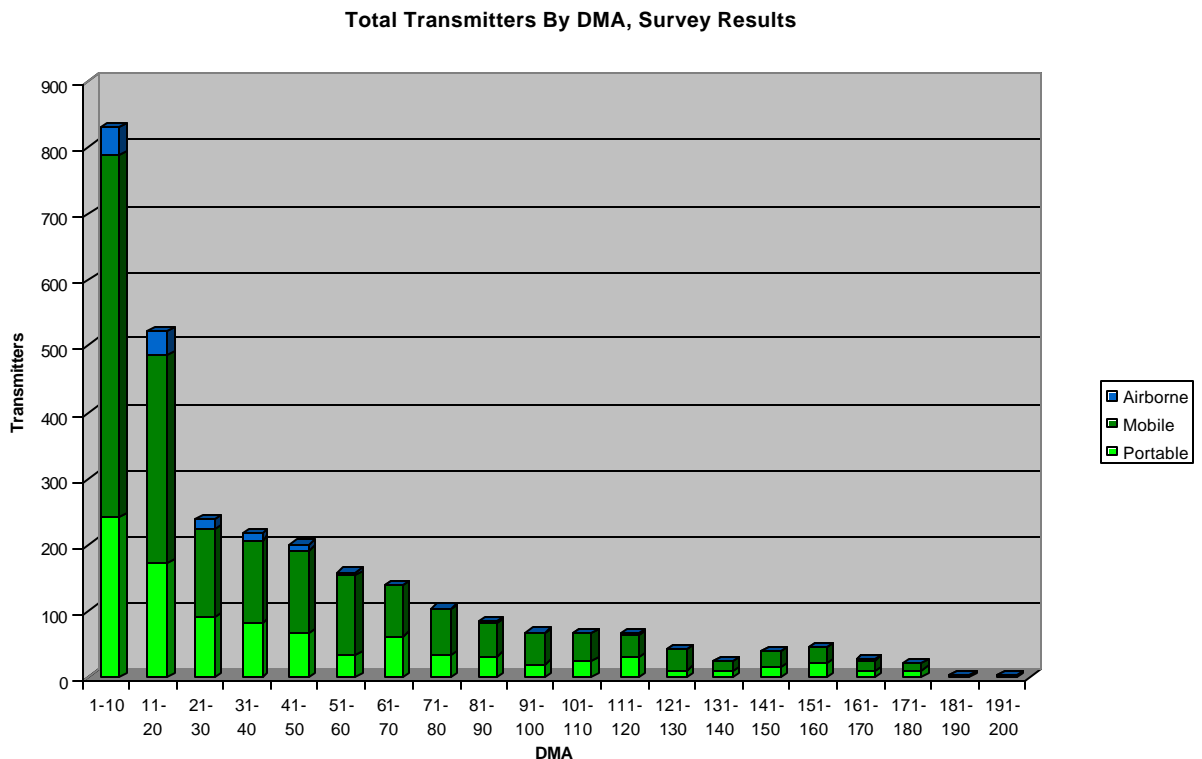
## Survey Results, Totals by DMA

The following figures illustrate the inventory of transmitter and receiver types by market grouping, with Figure 2 illustrating the total number of transmitters. Out of all transmitters only 0.5% of portable units, 5% of mobile units, and 8% of airborne units were recorded as being digital already.

Figure 3 illustrates the total number of receivers. Out of all receivers only 0.6% of mobile/portable units, 4.8% of airborne units, and 5.3% of fixed units were recorded as being already digital.

Figure 4 illustrates the total number of fixed or stationary central ENG receive antennas. Out of all antennas only 58% had the agile feed horn capabilities necessary to use polarization diversity bandwidth management techniques. Respondents ranked 23% of sites as easy to access, 42% as moderately accessible, and 35% as difficult to access for modifications necessary to add polarization diversity. Only 12% of respondents were able to respond that they knew their fixed site was already digital.

Figure 2



## Ad Hoc 2 GHz Reallocation Committee

Figure 3

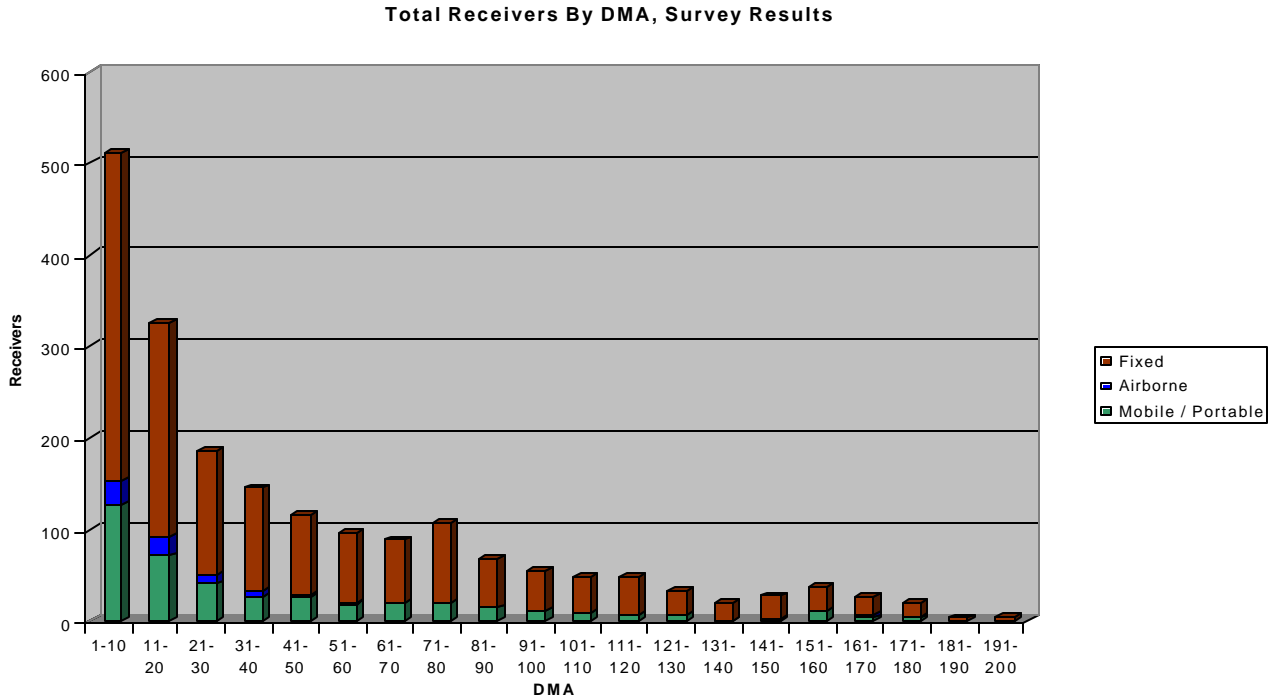
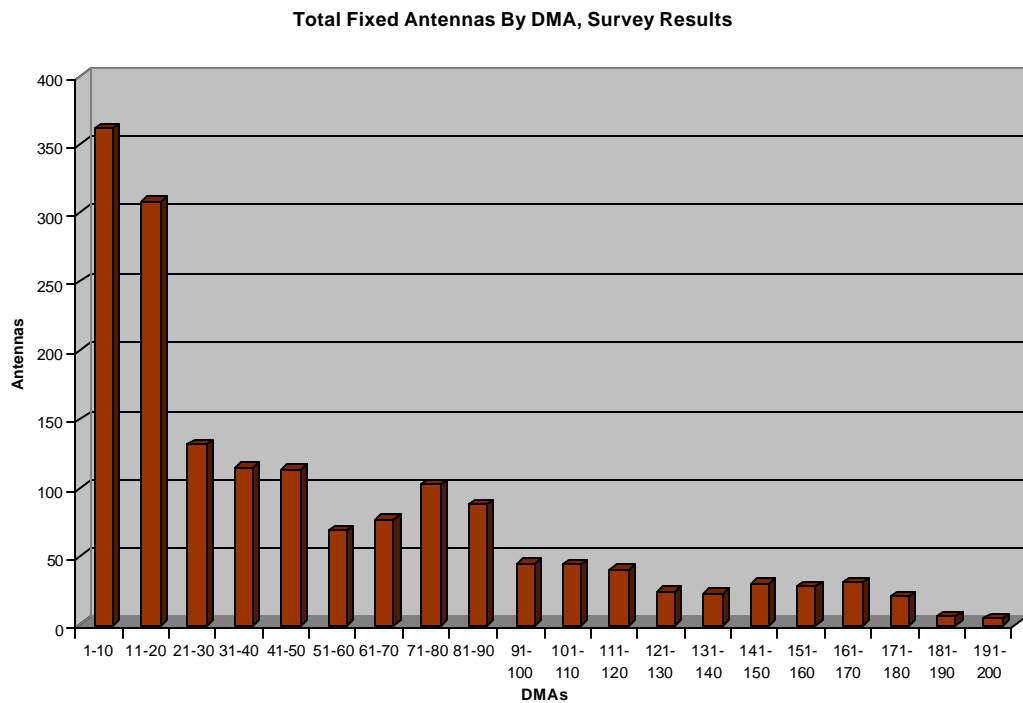


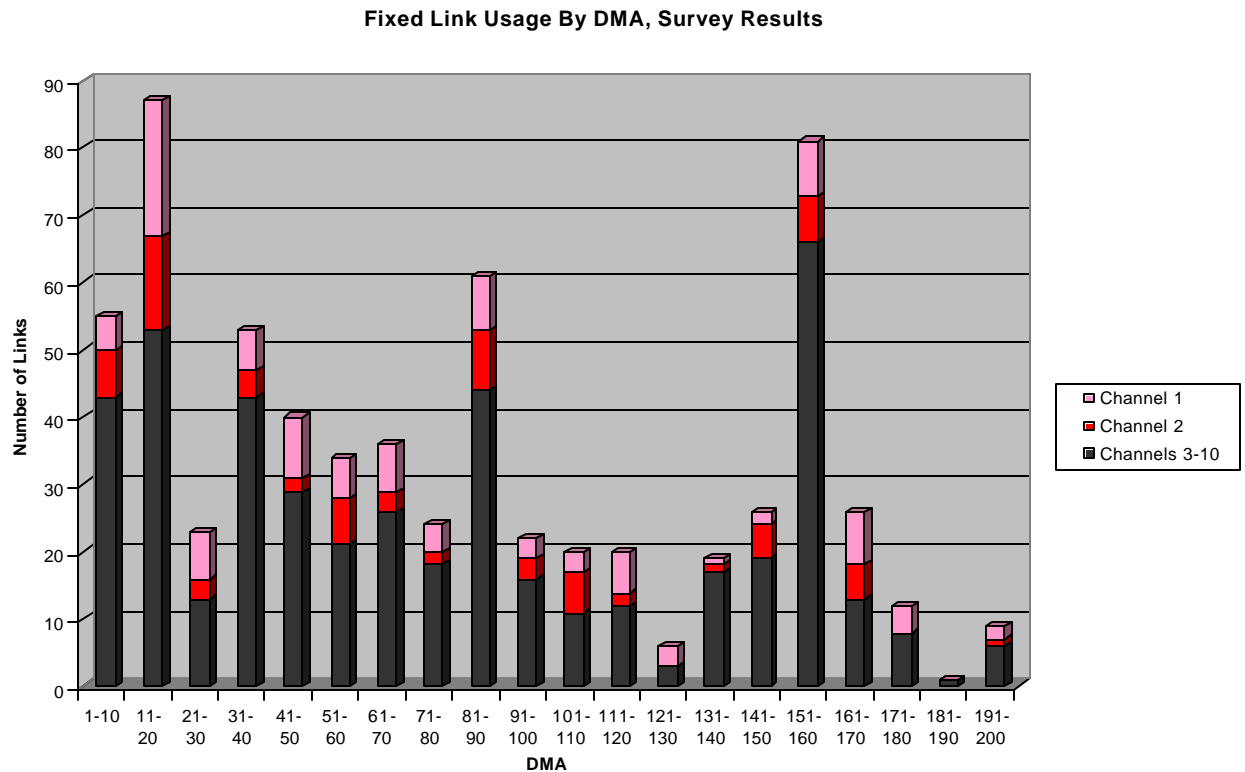
Figure 4



## Survey Results, Fixed Link Usage

Figure 5 illustrates the total number of fixed links respondents reported in use illustrated by market grouping and with usage on channels 1 and 2 broken out.<sup>9</sup>

Figure 5



## Projection of Survey Results to Total ENG Population at 2 GHz

One of the main factors in determining the total cost of the transition to digital is to estimate the total number of users and hardware operating in the 2 GHz bands. However, since the number of broadcasters operating ENG equipment in each market is different, it is difficult to extrapolate the total number of ENG users in the 2 GHz band from the total number of broadcasters in all 200 markets. A different criterion had to be used. The new criterion used below is based on the number of licensees in a market that originate local news. Specifically, it is assumed that a licensee that originates local news in a given market will require ENG equipment.

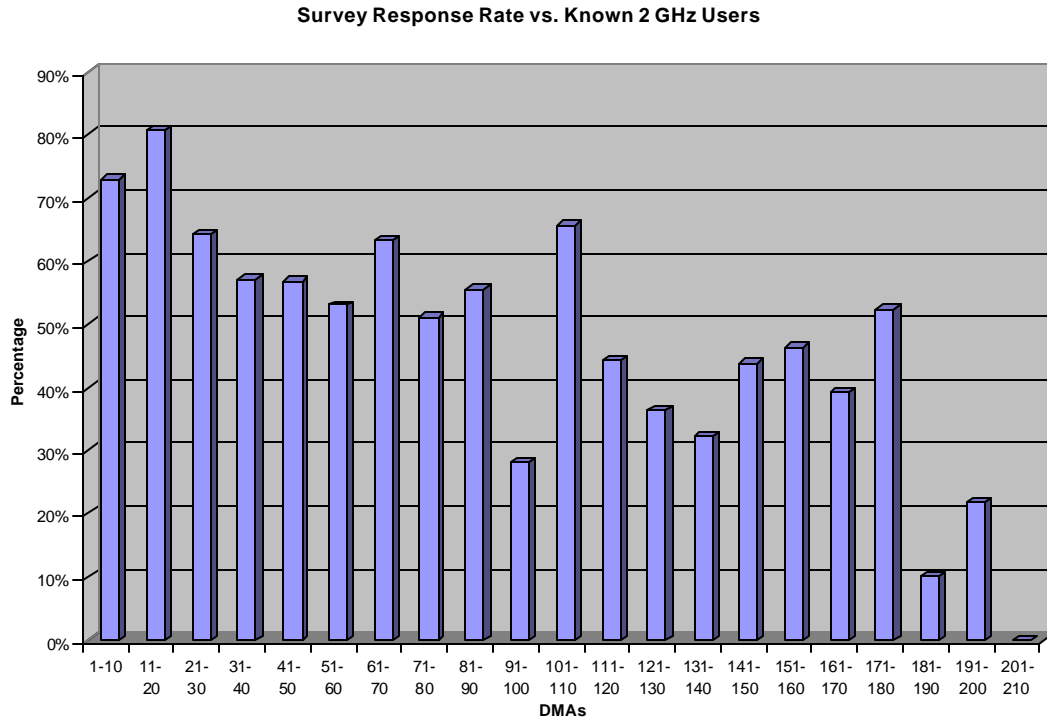
The projections of the total transmitter and receiver population use a database that contains the number of licensees that originate local news for the 210 markets.<sup>10</sup> The

<sup>9</sup> Variance in markets 151-160 reflects a multi-station multi-hop distribution system in one market.

## Ad Hoc 2 GHz Reallocation Committee

database was obtained from a report submitted to the FCC in the summer of 2003 by Economist Incorporated in the ownership proceedings.<sup>11</sup> These response rates by market grouping percentages are shown in Figure 6.<sup>12</sup> These percentages were then used to project the total number of transmitters and receivers in all markets. These projections are illustrated in Figures 7 and 8 respectively.

**Figure 6**



<sup>10</sup> No responses were received for markets 201-210. Because it is known there are 18 stations providing news coverage in those markets, the proportions for the previous market grouping were carried over.

<sup>11</sup> MB Docket 02-277, MM Docket 01-235, MM Docket 01-317 MM Docket 00-244, MM Docket 03-130.

<sup>12</sup> The all market overall response rate vs. known 2 GHz users was 52.5%.

## Ad Hoc 2 GHz Reallocation Committee

Figure 7

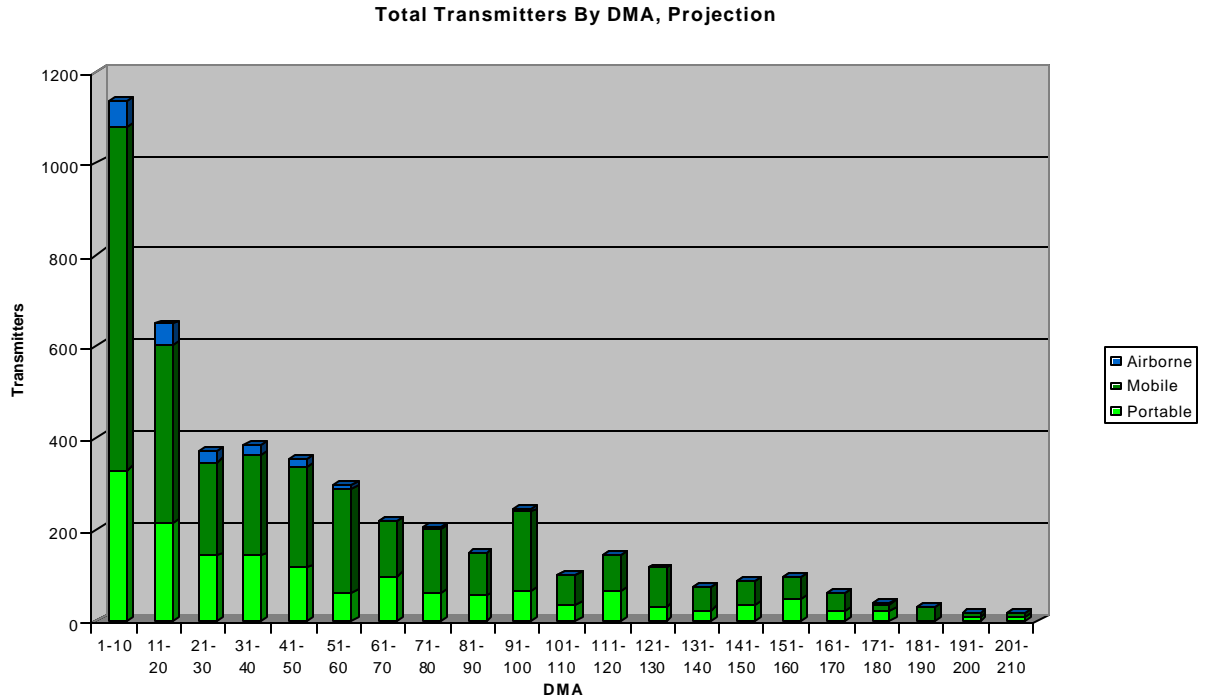
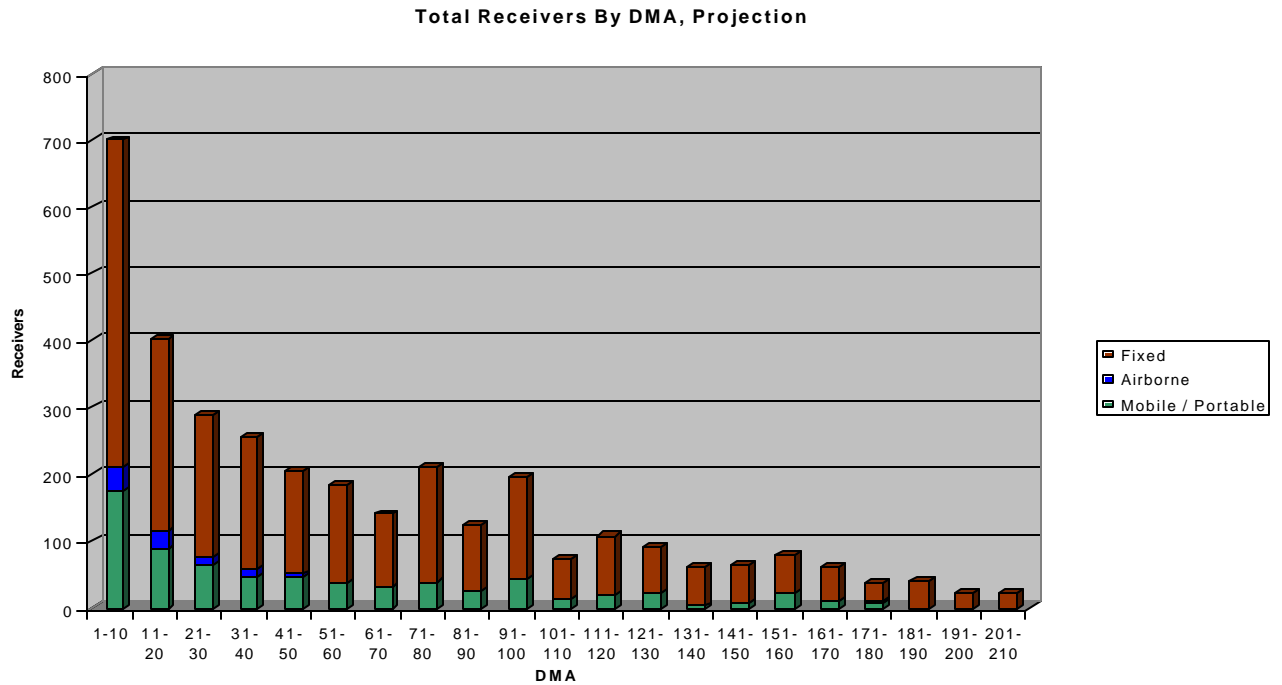


Figure 8



## Survey Results, Projected Digital Equipment Costs by DMA

## Ad Hoc 2 GHz Reallocation Committee

Estimates of replacement digital equipment and on-tower antenna modification costs were developed by manufacturer and broadcaster representatives within the Committee. These cost estimates are illustrated in Table 1. Soft and indirect cost percentages reflecting areas such as administrative expense, engineering costs, tax, incidental equipment requirements, etc. were also developed by Committee members, and are illustrated in Table 2.<sup>13</sup> The projected total numbers of transmitters, receivers, and antennas were then multiplied by these estimates and percentages.

Figure 9 illustrates the costs across market groupings to transition 2 GHz transmitters to digital operation, with the total cost across all DMAs approaching \$254 million.<sup>14</sup> Figure 10 illustrates the costs across market groupings to transition 2 GHz receivers to digital operation with the total cost across all DMAs a little more than \$53 million.<sup>15</sup> Figure 11 illustrates the total costs across market groupings to transition ENG transmitters, receivers and antennas to digital operation and including the overhead expenses illustrated in Table 2. Total aggregate cost across all DMAs is approximately \$397 million.<sup>16</sup>

**Table 1**

Description	List Price
Fixed Site Antenna Modification Costs - Easy Site	1,500
Fixed Site Antenna Modification Costs - Moderate Site	4,000
Fixed Site Antenna Modification Costs - Hard Site	6,000
Fixed Site Feed Assembly Replacement (2/7GHz, Quad Pol, LNA byps)	12,600
High Power Digital Capable 2 GHz TX	16,500
COFDM Encoder/Modulator	39,600
Fixed Analog/Digital 2GHz Rx (w/ FM Demod)	11,300
Portable 2GHz Analog/Digital Rx w/ COFDM Rx	15,300
COFDM Decoder/Demod	5,000

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<sup>13</sup> It should be noted that costs for installation of spectrum monitoring equipment, replacement helicopter tracking systems, and creation of an audio mix-minus to handle digital microwave link latency were deemed too difficult to directly estimate, and so an allowance was included in this percentage. However, these costs can run as much as \$500,000 to \$700,000 at a large television station depending on existing infrastructure.

<sup>14</sup> These amounts do not include any costs already incurred by stations prior to the survey.

<sup>15</sup> These amounts do not include any costs already incurred by stations prior to the survey.

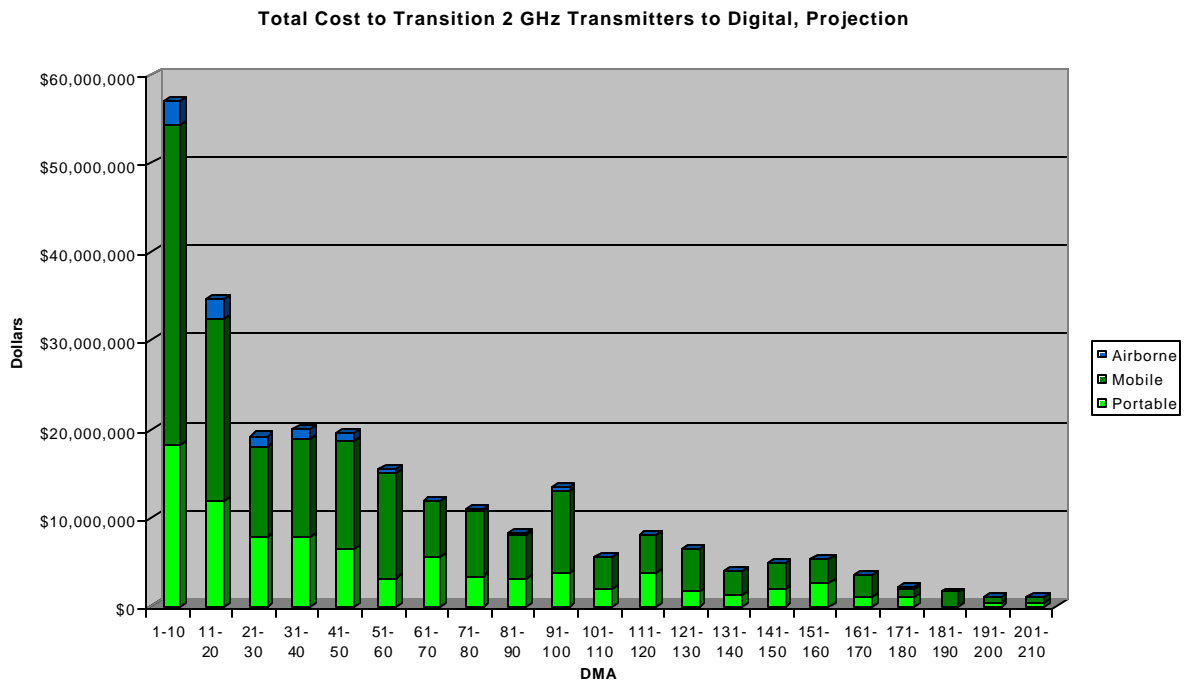
<sup>16</sup> These amounts do not include any costs already incurred by stations prior to the survey.

## Ad Hoc 2 GHz Reallocation Committee

**Table 2**

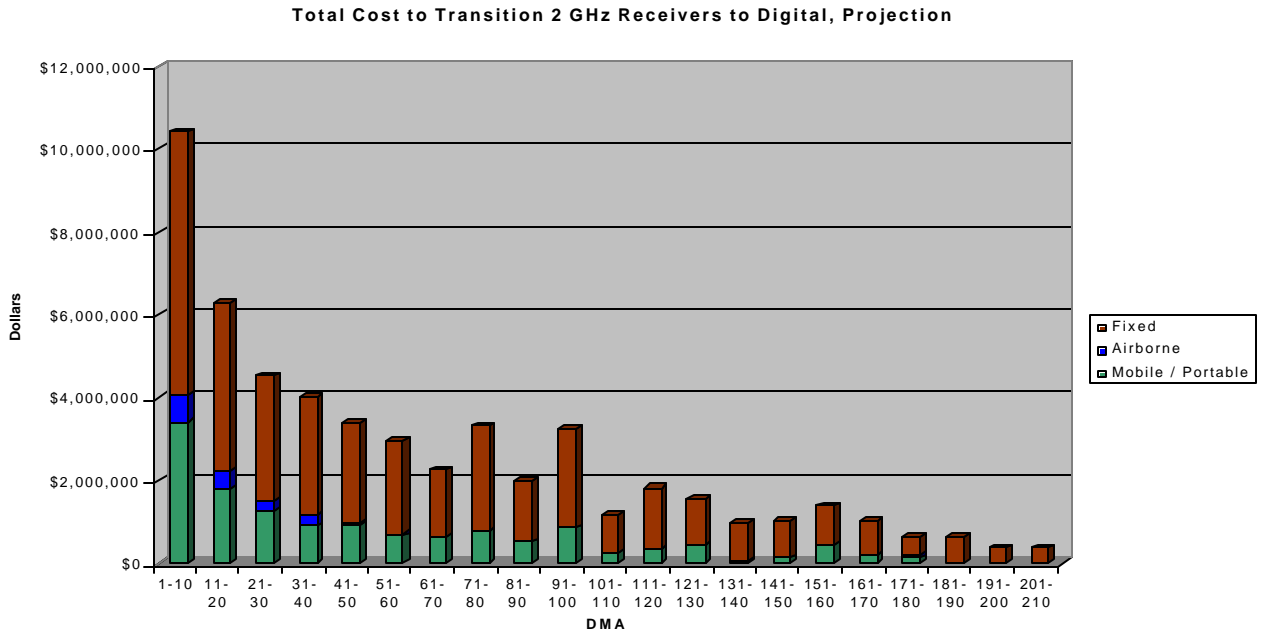
<b>Other Costs</b>	
Engineering	2%
FCC License Application Preparation & Filing	2%
Administrative/Shipping	2%
Remote Control Systems	3%
Audio Mix-Minus	2%
Non-tower Installation	3%
Tax	6%
<b>Total</b>	<b>20%</b>

**Figure 9**

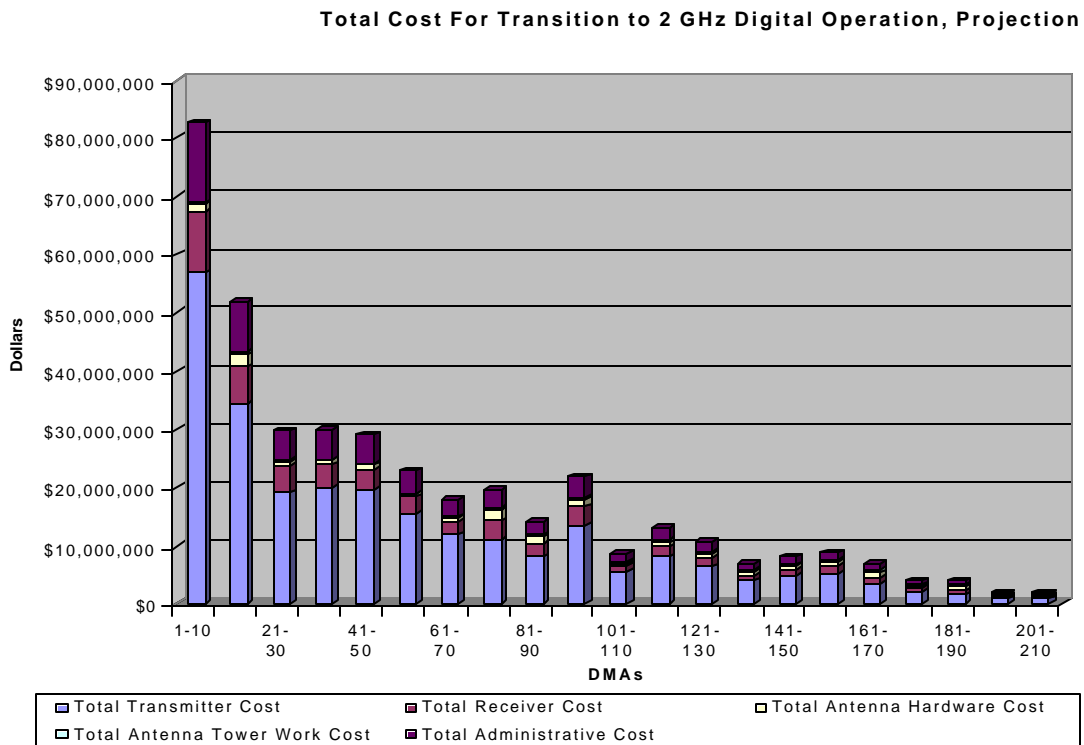


# Ad Hoc 2 GHz Reallocation Committee

**Figure 10**



**Figure 11**



## **Survey Results, Fixed Link Digital Equipment Costs by DMA**

Figure 12 illustrates the total costs across DMAs 1-200 to transition the fixed links identified by the survey respondents to digital operation. The estimated per link cost is approximately \$100,000. This represents the cost of a transmitter and receiver for a dual thread (redundant) RF “protected” system, but with only a single set of COFDM modulators and demodulators. This cost does not include the alteration of antenna systems, relocation to other bands, or other soft costs listed in Table 2. The total estimated cost to migrate the 655 fixed links reported by the survey respondents to digital operation using the above criteria is approximately \$65 million.<sup>17</sup>

In order to project to the total cost for all fixed links in the 2 GHz band a different methodology must be used than the one employed to project the total cost for ENG, since there is no correlation between fixed links and TV stations that do news. An examination of the Commission’s Universal Licensing Systems (ULS) database reveals that there are 1150 fixed links licensed as Studio Transmitter Links, Intercity Relays or Booster Relays versus the 655 reported by respondents. Using that higher tally and the aforementioned price per link the projected cost to transition fixed links is \$115 million. However, it is believed that that this is an under estimation. There are many factors that must be considered for fixed links in the 2 GHz band. For example, links on channels 1 and 2 may have to move to another band completely (e.g. the 7 or 13 GHz band) because it may be impossible to coordinate and “clear” a new 2 GHz link in many major markets due to congestion.<sup>18</sup> Each fixed link must be evaluated individually.

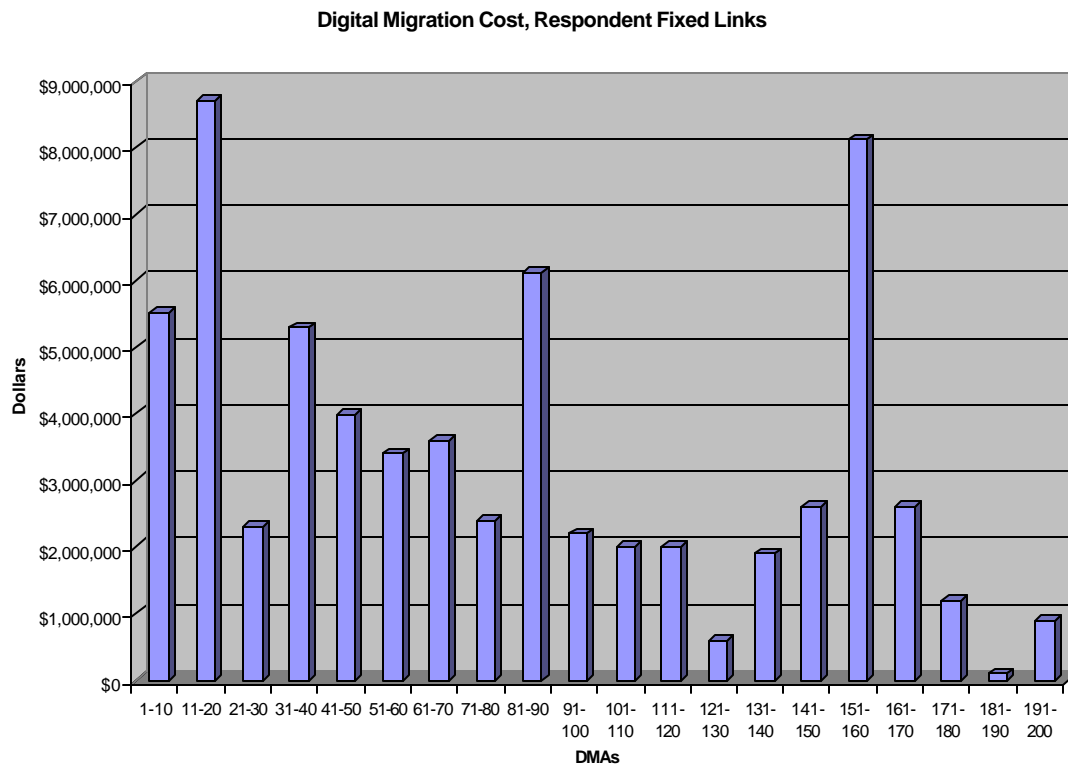
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<sup>17</sup> These amounts do not include any costs already incurred by stations prior to the survey.

<sup>18</sup> Note that ET Docket 00-258 proposes to move 11 Department of Defense uplinks into the 2 GHz band which may make finding an in band replacement channel even more difficult.

## Ad Hoc 2 GHz Reallocation Committee

**Figure 12**



# 2003 2 GHz BAS Census

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**PLEASE NOTE:** All responses are to be considered confidential and will be aggregated with other responses in your market to calculate an estimated transition cost. Answering this questionnaire will NOT commit either your facility or MSS to compensation or anything else. It will simply be used to generate the broadcast industry's best estimate on the costs and logistics involved in implementing a transition.

---

**Contact information: *Please Note, ALL fields in this block of data are REQUIRED***

<b>Station Call Sign:</b>	<input type="text"/>	<b>Contact Name:</b>	<input type="text"/>
<b><a href="#">Nielsen Market</a> No.:</b>	<input type="text"/>	<b>Contact Phone:</b>	<input type="text"/>
<b>License type:</b>	<input type="text" value="---"/>	<b>Contact E-mail:</b>	<input type="text"/>
<b><a href="#">FCC Facility ID:</a></b>	<input type="text"/>		

**Can we contact you for more information if needed? :** ☒ Yes ☐ No

---

**Please select the 2GHz channel(s) you primarily use during 2 GHz operations:**

Primary/Home

Secondary

Tertiary

**Please select your use of split or offset channel operations during ENG operations:**

☐ Infrequently - Only as Situation Warrants ☐ Frequently - Part of Daily Operations ☒ Never

**Please note the Audio Subcarriers you use in ENG operations:**

1st Subcarrier:  MHz  
Use:

2nd Subcarrier:  MHz  
Use:

3rd Subcarrier:  MHz  
Use:

---

Equipment Quantities		Band Capabilities (List Quantity of each Type by Age)						Digital Capabilities (List Quantity of each Type)			
		2/2.5 GHz Only		<u>Dual Band</u>		<u>Tri Band</u>		<u>Digital</u>	<u>Digital Ready</u>	<u>Analog: Band Plan Selectable</u>	<u>Analog: Fixed Plan or Legacy</u>
		0-3 Years	3+ Years	0-3 Years	3+ Years	0-3 Years	3+ Years				
<b>ENG Transmitters</b>											
Mobile	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Portable	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Aerial-Helicopter	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<b>ENG Receivers</b>											
Site Receivers	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Mobile/Portable	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Aerial-Helicopter	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<b>2 GHz Antennas</b>	<b>Quantity</b>										
	Fixed Polarity			<u>Antenna LNA Age</u>		<u>Digital Ready Antenna/LNA</u>		<b>Antenna Access</b>			
	Agile			0-3 Years	3+ Years	Yes	Unknown	<u>Easy</u>	<u>Moderate</u>	<u>Difficult</u>	
Fixed/Tower Site	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Portable	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

**Fixed Links:**

Operating Frequencies (List quantity of each):

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8	Ch 9	Ch 10
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Call Signs:



**Additional Comments (Optional):**



***ERROR OVERRIDE:*** *Would you like to submit this data and ignore all errors? Selecting YES will immediately submit your data to the database without ANY opportunity to correct errors.*      ☐ Yes      ☒ No

Submit Form

Reset Form

---

**Definitions:**

Digital: A transmitter or receiver that is already capable of operating digitally and can be re-channelled with a minimal amount of manufacturer's assistance.

Digital Ready: a transmitter or receiver that is capable of operating digitally by adding an OFDM Modulator or Demodulator and an MPEG coder or decoder to the existing radio. The radio **MUST** also be capable of changing channel center frequencies easily - preferably without manufacturer's assistance.

Analog; Bandplan Selectable: A transmitter or receiver that is not capable of passing a digital signal but can be moved to a newer channel plan. These radios usually have frequency synthesizers and can be re-channelled with a minimal amount of manufacturer's assistance.

**Analog; Fixed Plan or Legacy :** A transmitter or receiver that operates on a fixed bandplan, usually crystal controlled, and cannot be moved to a different channel plan without extensive manufacturer's help.

**Multiband, Dualband, Triband:** A transmitter or receiver that operates in more than a single band; for example 2/6 GHz, 2/6/13 GHz, 2/13 GHz, etc. To be included in this count, one of the bands the radio is capable of operating in MUST be 2 GHz. For this questionnaire, DO NOT consider 2/2.5 GHz radios to be multiband.

**Antenna/LNA Age:** Grouped by age, list the number of 2 GHz antennas/LNAs you have in your system. This total should equal the sum of the Fixed Polarity and Polarity agile antennas

**Digital Ready Antenna/LNA:** Enter the number of 2 GHz antennas/LNAs you have in your system that are capable of passing a digital signal. Things to consider include, but are not limited to, LNA signal compression, downconverter phase stability, etc. This total should equal the sum of the Fixed Polarity and Polarity agile antennas

**Antenna Access: Easy:** An antenna site that is easily accessible and does not require tower riggers to replace an antenna or LNA that is incapable of passing a digital signal. An example of this would be an ENG antenna mounted on the roof of a building or truck and can be worked on without requiring a helicopter or tower riggers.

**Antenna Access: Moderate:** An antenna site that is accessible and may or may not require tower riggers to replace an antenna or LNA that is incapable of passing a digital signal. An example of this would be an ENG antenna mounted on a tower up to 500 feet tall and can be worked on without requiring a helicopter.

**Antenna Access: Difficult:** An antenna site that is extremely difficult to get to or would require a significant investment in tower riggers time to replace an antenna or LNA that is incapable of passing a digital signal. An example of this would be an ENG antenna mounted to the top of a 500 foot or taller tower or requires a helicopter to access the site or antenna.